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OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

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[1] Withdrawn for publication elsewhere.

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THIRTY-FIRST ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Baltimore, Maryland, December 26 and 27, 1918

The thirty-first annual meeting of the American Association of Economic Entomologists will be held in Room 9, Gilman Hall, Johns Hopkins University, Baltimore, Md., on December 26 and 27, 1918.

Sessions will open at 10 a. m., Thursday, December 26. The annual reports and reports of committees will be presented, followed by the annual address of the President. The meeting of the general association will be continued at 1.30 p. m. On Friday a joint session will be held with the section on Horticultural Inspection, and a program has been arranged for Friday afternoon. If more time is necessary, the session will be continued on Friday evening.

Sectional Meetings

The meeting of the section on Apiculture will be held at 8 p. m., Thursday, December 26. The section on Horticultural Inspection will meet with the regular association in joint session, Friday morning.

Hotel Headquarters

Hotel headquarters for this association will be at the Southern Hotel, where rates of $3 per day and upward have been secured. Members are urgently requested to secure reservations of rooms in advance, and, if hotel facilities are not available, they should communicate with Miss L. M. Bollman, Librarian of the Johns Hopkins University, Baltimore, Md., who will arrange for rooms in private families. Miss Bollman has been authorized to act for the American Association for the Advancement of Science in this matter, and members desiring accommodations should state clearly whether they desire a room with board, room without board, or board only, the dates they expect to occupy room and the maximum price they wish to pay. Prompt attention to this matter will add materially to the success of the meeting.

Railroad Rates

Information concerning railroad rates to the meeting should be secured direct from Dr. L. O. Howard, Permanent Secretary, Smithsonian Institution, Washington, D. C.

Official Buttons

Official buttons for members of the association will be furnished to all those who have paid their dues for 1918. Applications for buttons should be made to the secretary at the time of the meeting.

Membership

Application blanks for membership can be secured from the secretary, or from members of the committee on membership, and all applications should be made out, properly endorsed, and filed with the membership committee on or before December 26.

Program

Thursday, December 26, 1918, 10.00 a. m.

Report of the Secretary.
Report of the executive committee, by President E. D. Ball.
Report of the employment bureau, by W. E. Hines, Auburn, Ala.
Report of the committee on nomenclature, by W. E. Britton, New Haven, Conn.
Report of the committee on entomological investigations, by W. J. Schoene, Blacksburg, Va.
Report of the committee on index of economic entomology, by E. P. Felt, Albany, N. Y.
Report of the committee on war service, by S. A. Forbes, Urbana, Ill.
Report of the committee on proposed amendment to the Constitution, by E. P. Felt, Albany, N. Y.
Appointment of committees.
Miscellaneous business.
New business.
Annual address of the President, E. D. Ball, Ames, Iowa.
"Economic Entomology—Its Foundation and Future."

Reading of Papers

"Practical Operation of Submergence as a Method of Controlling the Sprinkling Sewage Filter Fly," by Thomas J. Headlee, New Brunswick, N. J. (15 minutes.) Lantern.

"The Dispersion of Flies by Flight," by F. C. Bishopp and E. W. Laake, Dallas, Tex. (15 minutes.)

Results of experiments to determine the distance flies will travel. House flies and blow flies have been found to fly much farther than previously reported.

"The Control of the Body Louse on Clothes by Fumigation Methods," by G. H. Lamson, Jr., Storrs, Conn. (5 minutes.)

"Notes on *Phlebotomus sp.* Attacking Man," by D. C. Parman, Uvalde, Tex. (10 minutes.)

Seasonal occurrence, means of attack and habits with suggestion of transmission of disease.

"The Occurrence of *Drosophila* larvæ and puparia in bottled milk," by William A. Riley, St. Paul, Minn. (10 minutes.) Lantern.

"Some new practical Phases of the Entomology of Disease, Hygiene and Sanitation Developed by the War," by W. Dwight Pierce, Washington, D. C. (15 minutes.)

This paper will discuss new developments in the house fly, mosquito and cootie problems especially.

Adjournment.

Program

Thursday, December 26, 1918, 1.30 p. m.

Discussion of the Presidential Address.

Reading of Papers

"Biological Notes on Some Flatheaded Bark Borers of the Genus *Melanophila*," by H. E. Burke, Los Gatos, Calif. (10 minutes.)

"The Oak Twig Girdler (*Agrilus arcuatus* and var. *torquatus*)," by A. G. Ruggles, St. Paul, Minn. (10 minutes.) Lantern.

This insect is responsible for the destruction of 90 per cent of the dying oaks of the red group, and is doing a great amount of damage in Minnesota.

"On the Absence of Insect Pests in Certain Localities and on Certain Plants," by T. D. A. Cockerell, Boulder, Col. (5 minutes.)

"The Life-Cycle of *Lachnosterna lanceolata* Say.," by Wm. P. Hayes, Manhattan, Kan. (15 minutes.)

"Notes on Three Little Known Clover Pests," by Glenn W. Herrick and J. D. Detwiler. (8 minutes.)

"The Ohio Wheat Survey," by H. A. Gossard, Wooster, Ohio, and H. T. Parks, Columbus, Ohio. (15 minutes.)

Review of work for two seasons locating areas infested by various wheat pests and value of work in determining date for seeding and what cultural advice is needed.

"*Eleodes opaca* Say., An Important Enemy of Wheat in the Great Plains Area," by J. W. McColloch, Manhattan, Kan. (12 minutes.)

Life economy, economic importance, enemies, and some suggestions for its control.

"A Much Neglected Factor in Natural Control of Grain Aphis Epidemics—*Hippodamia convergens* Guer.," by A. C. Burrill, Pullman, Wash. (5 minutes.)

This paper will give some idea of the number and wide distribution of lady beetle caches, history of their use in the Northwest, some figures on comparative costs of control measures in favor of using beetles.

"Nineteen Hundred and Eighteen (1918) Outbreak and Control of *Melanoplus atlanis*," by E. G. Kelly, Manhattan, Kan. (15 minutes.)

Beginning of the outbreak in 1917—Discing for control. Campaign for poisoning in spring 1918—followed by second campaign for late seeding of wheat and poisoning.

"Experiments with Poison Bait against Grasshoppers," by D. A. Ricker, W. Lafayette, Ind. (10 minutes.)

Results obtained from a series of experiments with several poisons and a number of baits alone and in combination. Also comparison of results with complete meteorological data during the period.

"Reducing the Cost of Poison Baits," by J. J. Davis, Lafayette, Ind. (7 minutes.)

A short note summarizing results from all over the country as to the value of crude arsenious oxide.

"Methods of Obtaining Data from Field Experiments," by W. P. Flint, C. F. Turner and J. J. Davis, W. Lafayette, Ind. (10 minutes.)

Comparative methods for making insect counts with special reference to Hessian fly.

"Value of Shuck Covering in Conserving Corn in the Extreme South," "*The French Bark Thiers* and her cargo of Australian Wheat," by E. A. Back, Washington, D. C. (10 minutes.)

"Insects Affecting Wheat Flour and Wheat Flour Substitutes," by Royal N. Chapman, Minneapolis, Minn. (15 minutes.)

The war-time emergency—the relative susceptibility of various cereals to insect attack—methods of control, in mills, for small consumers, and for large consumers.

Adjournment.

SECTION ON APICULTURE

FRANKLIN SHERMAN, Jr., *Chairman.* G. M. BENTLEY, *Secretary.*

Program

Thursday, December 26, 8.00 p. m.

Address by the Chairman, Franklin Sherman, Jr., Raleigh, N. C.

READING OF PAPERS AND DISCUSSIONS

"Beekeeping Since the Declaration of War," by E. F. Phillips, Washington, D. C. (15 minutes.)

"Developing Commercial Beekeeping in a Clover Region," by Morley Pettit, Georgetown, Ont. (15 minutes.)

"Relative Importance of Management and Breeding of Bees," by E. L. Sechrist, Washington, D. C. (15 minutes.)

"The Work of the Entomologist in Developing Bee Husbandry within the Limits of His State," by Thomas J. Headlee, New Brunswick, N. J. (15 minutes.)

"The Present Outlook in Beekeeping," by E. R. Root, Medina, Ohio. (15 minutes.)

"The Relation of Beekeeping to Bee Behavior," by George S. Demuth, Washington, D. C. (15 minutes.)

"Beekeeping Clubs and the Work of the Apiculturist in the Division of Extension," by George S. Rea, Ithaca, N. Y. (Stereopticon, 15 minutes.)

"Boys and Girls Bee Clubs," by Frank C. Pellett, Hamilton, Ill.

Transaction of Business.

Selection of Officers.

Adjournment.

Program

Friday, December 27, 10.00 a. m.

This association will meet with the section on Horticultural Inspection. Mr. E. C. Cotton, chairman of the section, will preside.
Address by the chairman, E. C. Cotton, Columbus, Ohio.

Reading of Papers

"Recent Work of the Federal Horticultural Board," by C. L. Marlatt, Washington, D. C. (15 minutes.)

"The Status of the Oriental Peach Moth," by Ernest N. Cory, Washington, D. C. (12 minutes.) Lantern.

"Present Status in the United States of the Oriental Peach Moth and Japanese Beetle," by A. L. Quaintance, Washington, D. C. (15 minutes.)

"Control Work against the Japanese Beetle," by W. H. Goodwin, New Brunswick, N. J. (15 minutes.)

"The European Corn Borer Problem," by D. J. Caffrey, Melrose Highlands, Mass. (15 minutes.) Lantern.

Statement of the serious nature of this imported pest and the danger of widespread injury to the corn crop.

"Important Insect Pests Collected on Imported Nursery Stock in 1918," by E. R. Sasscer, Washington, D. C. (10 minutes.)

"Organization for Insect Suppression," by A. F. Burgess, Melrose Highlands, Mass. (15 minutes.)

"Discovery of the European Potato Wart Disease in Pennsylvania," by J. G. Sanders, Harrisburg, Pa. (5 minutes.)

"An European Scale Insect Becoming a Menace in Pennsylvania," by J. G. Sanders, Harrisburg, Pa. (5 minutes.)

Selection of Section Officers.

Adjournment.

Program

Friday, December 27, 1.30 p. m.

Reading of Papers

"The Morphology, Behavior and Susceptibility of the Eggs of Three Imported Apple Plant Lice," by Alvah Peterson, New Brunswick, N. J. (15 minutes.) Lantern.

Facts pertaining to the structure and behavior of the egg coverings during the dormant and hatching periods, and to the progressive susceptibility of the eggs during the early spring to common contact insecticides and other chemicals. Variations in percentage of moisture and degrees of temperature also influenced by percentage of hatch.

"Recent Developments in Fumigation with Liquid Hydrocyanic-acid," by R. S. Woglum, Alhambra, Calif. (15 minutes.)

Results of field observations and experiments in dosage and gas distribution.

"High Temperature Fumigation and Methods of Estimating Radiation Required," by W. H. Goodwin, New Brunswick, N. J. (10 minutes.)

"Kerosene Emulsion *versus* Nicotine Solution for Combatting the Potato Aphid," by W. E. Britton and M. P. Zappe, New Haven, Conn. (10 minutes.)

Serious outbreak of the insect caused local scarcity of nicotine solution. It was demonstrated that the materials for making kerosene emulsion could be obtained at about half the cost.

"The Potato Leafhopper (*Empoasca mali*) and the Leaf Burn It Causes," by E. D. Ball, Ames, Iowa. (15 minutes.) Lantern.

A widespread and destructive outbreak of marginal burning of potato leaves was found to be caused by this leaf-hopper.

"Some Notes on *Phorbia fusciceps* as a Bean Pest," by Ira M. Hawley, Ithaca, N. Y. (10 minutes.) Lantern.

Notes on life history, injury and prevention of damage from the insect.

"*Phorbia fusciceps* Zett., Biological Notes, Injury to Lima Beans," by David E. Fink, Riverton, N. J. (10 minutes.)

"Parasite Introduction as a Means of Saving Sugar," by T. E. Holloway, Audubon Park, New Orleans, La. (15 minutes.)

A report of progress on the introduction of tachinid parasites of the sugar-cane moth borer (*Diatræa saccharalis*).

"Limitations in Insect Suppression," by Walter C. O'Kane, Durham, N. H. (15 minutes.)

"Entomological Needs," by J. J. Davis, W. Lafayette, Ind. (15 minutes.)

A résumé based on questionnaires and personal experience on points of improvement in bulletins and other entomological information for county agents and farmers, and the needs of agricultural students.

"Coöperative Extension Entomology in Texas," by A. H. Hollinger, College Station, Tex. (15 minutes.)

Results obtained under the Emergency Appropriation, and scope and plans for the season of 1918–1919.

"Combining Dormant and First Summer Spray in Apple Orchards," by T. J. Talbert, Columbia, Mo. (10 minutes.)

The results obtained in controlling San José scale by applying the concentrated lime sulphur solution (1–7) just before apple trees bloom but after the cluster buds have separated.

"Control of the Chrysanthemum Gall Midge with Nicotine Sulphate,—With Notes on Life Cycle," by T. L. Guyton, Harrisburg, Pa. (5 minutes.) Lantern.

"Economic Aspects of the Syrphidæ of Maine," by C. L. Metcalf, Columbus, Ohio. (5 minutes.)

A brief discussion of the unusual richness in number of species of the *aphidophagous* genera as compared with other states; and other economic phases.

Final Business

Report of committee on auditing.

Report of committee on resolutions.

Report of committee on membership.

Report of other committees.

Nomination of Journal officers by advisory committee.

Report of committee on nominations.

Election of officers.

Miscellaneous business.

Fixing the time and place of next meeting.

Final adjournment.

E. D. Ball, *President*,
Ames, Iowa.

A. F. Burgess, *Secretary*,
Melrose Highlands, Mass.

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

(Organized 1889, Incorporated December 29, 1913)

OFFICERS, 1918

President
E. D. BALL, Madison, Wisconsin.

First Vice-President
W. C. O'KANE, Durham, New Hampshire.

Second Vice-President (Pacific Slope Branch)
GEORGE P. WELDON, Sacramento, California.

Third Vice-President (Horticultural Inspection)
E. C. COTTON, Columbus, Ohio.

Fourth Vice-President (Apiculture)
FRANKLIN SHERMAN, JR., Raleigh, North Carolina.

Secretary
A. F. BURGESS, Melrose Highlands, Massachusetts.

PACIFIC SLOPE BRANCH

Secretary
E. O. ESSIG, Ventura, California.

SECTION OF HORTICULTURAL INSPECTION

Secretary
J. G. SANDERS, Harrisburg, Pennsylvania.

SECTION OF APICULTURE

Secretary
G. M. BENTLEY, Knoxville, Tennessee.

STANDING COMMITTEES

Committee on Nomenclature
W. E. BRITTON, Chairman, New Haven, Conn. Term expires 1918.
GLENN W. HERRICK, Ithaca, N. Y. Term expires 1919.
EDITH M. PATCH, Orono, Me. Term expires 1920.

Committee on Entomological Investigations
W. J. SCHOENE, Chairman, Blacksburg, Va. Term expires 1919.
H. T. FERNALD, Amherst, Mass. Term expires 1918.
GEORGE A. DEAN, Manhattan, Kan. Term expires 1920.

Committee on Membership
J. J. DAVIS, West Lafayette, Ind., Chairman. Term expires 1918.
W. E. BRITTON, New Haven, Conn. Term expires 1919.
T. J. HEADLEE, New Brunswick, N. J. Term expires 1920.

Councillors for the American Association for the Advancement of Science
H. A. GOSSARD, Wooster, Ohio.
R. A. COOLEY, Bozeman, Mont.

Entomologists' Employment Bureau
W. E. HINDS, Director, Auburn, Ala.

LIST OF MEETINGS AND PAST OFFICERS

First Annual Meeting, Washington, D. C., Nov. 12–14, 1889. President, C. V. Riley; First Vice-President, S. A. Forbes; Second Vice-President, A. J. Cook; Secretary, John B. Smith.

Second Annual Meeting, Champaign, Ill., Nov. 11–13, 1890. (The same officers had charge of this meeting.)

Third Annual Meeting, Washington, D. C., Aug. 17–18, 1891. President, James Fletcher; First Vice-President, F. H. Snow; Second Vice-President, Herbert Osborn; Secretary, L. O. Howard.

Fourth Annual Meeting, Rochester, N. Y., Aug. 15–16, 1892. President, J. A. Lintner; First Vice-President, S. A. Forbes; Second Vice-President, J. H. Comstock; Secretary, F. M. Webster.

Fifth Annual Meeting, Madison, Wis., Aug. 14–16, 1893. President, S. A. Forbes; First Vice-President, C. J. S. Bethune; Second Vice-President, John B. Smith; Secretary, H. Garman.

Sixth Annual Meeting, Brooklyn, N. Y., Aug. 14–15, 1894. President, L. O. Howard; First Vice-President, John B. Smith; Second Vice-President, F. L. Harvey; Secretary, C. P. Gillette.

Seventh Annual Meeting, Springfield, Mass., Aug. 27–28, 1895. President, John B. Smith; First Vice-President, C. H. Fernald; Secretary, C. L. Marlatt.

Eighth Annual Meeting, Buffalo, N. Y., Aug. 21–22, 1896. President, C. H. Fernald; First Vice-President, F. M. Webster; Second Vice-President, Herbert Osborn; Secretary, C. L. Marlatt.

Ninth Annual Meeting, Detroit, Mich., Aug. 12–13, 1897. President, F. M. Webster; First Vice-President, Herbert Osborn; Second Vice-President, Lawrence Bruner; Secretary, C. L. Marlatt.

Tenth Annual Meeting, Boston, Mass., Aug. 19–20, 1898. President, Herbert Osborn; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, C. L. Marlatt.

Eleventh Annual Meeting, Columbus, Ohio, Aug. 18–19, 1899. President, C. L. Marlatt; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, A. H. Kirkland.

Twelfth Annual Meeting, New York, N. Y., June 22–23, 1900. President Lawrence Bruner; First Vice-President, C. P. Gillette; Second Vice-President, E. H. Forbush; Secretary, A. H. Kirkland.

Thirteenth Annual Meeting, Denver, Colo., Aug. 23–24, 1901. President, C. P. Gillette; First Vice-President, A. D. Hopkins; Second Vice-President, E. P. Felt; Secretary, A. L. Quaintance.

Fourteenth Annual Meeting, Pittsburgh, Pa., June 27–28, 1902. President, A. D. Hopkins; First Vice-President, E. P. Felt; Second Vice-President, T. D. A. Cockerell; Secretary, A. L. Quaintance.

Fifteenth Annual Meeting, Washington, D. C., Dec. 26–27, 1902. President, E. P. Felt; First Vice-President, W. H. Ashmead; Second Vice-President, Lawrence Bruner; Secretary, A. L. Quaintance.

Sixteenth Annual Meeting, St. Louis, Mo., Dec. 29–31, 1903. President, M. V. Slingerland; First Vice-President, C. M. Weed; Second Vice-President, Henry Skinner; Secretary, A. F. Burgess.

Seventeenth Annual Meeting, Philadelphia, Pa., Dec. 29–30, 1904. President, A. L. Quaintance; First Vice-President, A. F. Burgess; Second Vice-President, Mary E. Murtfeldt; Secretary, H. E. Summers.

Eighteenth Annual Meeting, New Orleans, La., Jan. 1–4, 1906. President, H. Garman; First Vice-President, E. D. Sanderson; Second Vice-President, F. L. Washburn; Secretary, H. E. Summers.

Nineteenth Annual Meeting, New York, N. Y., Dec. 28–29, 1906. President, A. H. Kirkland; First Vice-President, W. E. Britton; Second Vice-President, H. A. Morgan; Secretary, A. F. Burgess.

Twentieth Annual Meeting, Chicago, Ill., Dec. 27–28, 1907. President, H. A. Morgan; First Vice-President, H. E. Summers; Second Vice-President, W. D. Hunter; Secretary, A. F. Burgess.

Twenty-first Annual Meeting, Baltimore, Md., Dec. 28–29, 1908. President, S. A. Forbes; First Vice-President, W. E. Britton; Second Vice-President, E. D. Ball; Secretary, A. F. Burgess.

Twenty-second Annual Meeting, Boston, Mass., Dec. 28–29, 1909. President, W. E. Britton; First Vice-President, E. D. Ball; Second Vice-President, H. E. Summers; Secretary, A. F. Burgess.

Twenty-third Annual Meeting, Minneapolis, Minn., Dec. 28–29, 1910. President, E. D. Sanderson; First Vice-President, H. T. Fernald; Second Vice-President, P. J. Parrott; Secretary, A. F. Burgess.

Twenty-fourth Annual Meeting, Washington, D. C., Dec. 27–29, 1911. President, F. L. Washburn; First Vice-President, E. D. Ball; Second Vice-President, R. H. Pettit; Secretary, A. F. Burgess.

Twenty-fifth Annual Meeting, Cleveland, Ohio, Jan. 1–3, 1913. President, W. D. Hunter; First Vice-President, T. J. Headlee; Second Vice-President, R. A. Cooley; Secretary, A. F. Burgess.

Twenty-sixth Annual Meeting, Atlanta, Ga., Dec. 31, 1913–Jan. 2, 1914. President, P. J. Parrott; First Vice-President, E. L. Worsham; Second Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Twenty-seventh Annual Meeting, Philadelphia, Pa., Dec. 28–31, 1914. President, H. T. Fernald; First Vice-President, Glenn W. Herrick; Second Vice-President, W. E. Britton; Third Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Special Meeting, Berkeley, Cal., Aug. 9–10, 1915. (Officers same as for Twenty-eighth Annual Meeting.)

Twenty-eighth Annual Meeting, Columbus, Ohio, Dec. 27–30, 1915. President, Glenn W. Herrick; First Vice-President, R. A. Cooley; Second Vice-President, W. E. Rumsey; Third Vice-President, E. F. Phillips; Secretary, A. F. Burgess.

Twenty-ninth Annual Meeting, New York, N. Y., Dec. 28–30, 1916. President, C. Gordon Hewitt; First Vice-President, G. A. Dean; Second Vice-President, E. D. Ball; Third Vice-President, W. J. Schoene; Fourth Vice-President, T. J. Headlee; Secretary, A. F. Burgess.

Thirtieth Annual Meeting, Pittsburgh, Pa., Dec. 31, 1917–Jan. 2, 1918. President, R. A. Cooley; First Vice-President, W. E. Hinds; Second Vice-President, A. W. Morrill; Third Vice-President, G. M. Bentley; Fourth Vice-President, B. N. Gates; Secretary, A. F. Burgess.

LIST OF MEMBERS

ACTIVE MEMBERS

Ainslie, C. N., 5009 Orleans Ave., Sioux City, Iowa.
Ainslie, George G., R. R. 9, Knoxville, Tenn.
Aldrich, J. M., U. S. Bureau of Entomology, West Lafayette, Ind.
Back, E. A., U. S. Bureau of Entomology, Washington, D. C.
Baker, C. F., Singapore, Straits Settlements.
Ball, E. D., State Capitol, Madison, Wis.
Banks, C. S., College of Agriculture, Los Banos, P. I.
Banks, Nathan, Museum of Comparative Zoölogy, Cambridge, Mass.
Barber, H. S., U. S. Bureau of Entomology, Washington, D. C.
Becker, G. G., Agricultural Experiment Station, Fayetteville, Ark.
Bentley, G. M., University of Tennessee, Knoxville, Tenn.
Berger, E. W., University of Florida, Gainesville, Fla.
Bethune, C. J. S., Guelph, Ontario, Canada.
Bishopp, F. C., U. S. Bureau of Entomology, Dallas, Texas.
Britton, W. E., Agricultural Experiment Station, New Haven, Conn.
Brooks, F. E., U. S. Bureau of Entomology, French Creek, W. Va.
Brues, C. T., Bussey Institution, Forest Hills, Boston, Mass.
Bruner, Lawrence, Agricultural Experiment Station, Lincoln, Neb.
Burgess, A. F., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Burke, H. E., Los Gatos, Cal.
Busck, August, U. S. National Museum, Washington, D. C.
Caesar, Lawson, Ontario Agricultural College, Guelph, Canada.
Caffrey, D. J., U. S. Bureau of Entomology, Hagerstown, Md.
Caudell, A. N., U. S. National Museum, Washington, D. C.
Chittenden, F. H., U. S. Bureau of Entomology, Washington, D. C.
Coad, B. R., U. S. Bureau of Entomology, Tallulah, La.
Cockerell, T. D. A., Boulder, Colo.
Collins, C. W., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Comstock, J. H., Cornell University, Ithaca, N. Y.
Conradi, A. F., Clemson College, S. C.
Cook, Mel. T., Agricultural Experiment Station, New Brunswick, N. J.
Cooley, R. A., Agricultural Experiment Station, Bozeman, Mont.
Cory, E. N., Agricultural Experiment Station, College Park, Md.
Cotton, E. C., Department of Agriculture, Columbus, Ohio.
Crawford, J. C., U. S. National Museum, Washington, D. C.
Creel, C. W., U. S. Bureau of Entomology, Forest Grove, Oregon.
Criddle, Norman, Treesbank, Manitoba, Canada.
Crosby, C. R., Cornell University, Ithaca, N. Y.
Crossman, S. S., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Davis, J. J., U. S. Bureau of Entomology, West Lafayette, Ind.
Dean, George A., Agricultural Experiment Station, Manhattan, Kan.
Ehrhorn, E. M., Honolulu, H. T.
Essig, E. O., Ventura, Cal.
Felt, E. P., State Museum, Albany, N. Y.
Fernald, C. H., Agricultural College, Amherst, Mass.
Fernald, H. T., Agricultural College, Amherst, Mass.
Fiske, W. F., South Hanson, Mass.

Flint, W. P., 1231 W. Edwards St., Springfield, Ill.
Forbes, S. A., University of Illinois, Urbana, Ill.
Foster, S. W., 201 Sansome St., San Francisco, Cal.
Franklin, H. J., East Wareham, Mass.
Fullaway, D. T., Agricultural Experiment Station, Honolulu, H. T.
Fulton, B. B., Agricultural Experiment Station, Geneva, N. Y.
Gahan, A. B., Berwyn, Md.
Garman, H., Agricultural Experiment Station, Lexington, Ky.
Gates, B. N., Agricultural Experiment Station, Amherst, Mass.
Gibson, Arthur, Entomological Branch, Ottawa, Canada.
Gillette, C. P., Agricultural Experiment Station, Fort Collins, Colo.
Goodwin, W. H., care Economic Zoölogist, Harrisburg, Pa.
Gossard, H. A., Agricultural Experiment Station, Wooster, Ohio.
Harned, R. W., Agricultural College, Miss.
Hart, C. A., Illinois State Laboratory of Natural History, Urbana, Ill.
Hartzell, F. Z., Agricultural Experiment Station, Fredonia, N. Y.
Headlee, T. J., Agricultural Experiment Station, New Brunswick, N. J.
Herms, W. B., University of California, Berkeley, Cal.
Herrick, Glenn W., Cornell University, Ithaca, N. Y.
Hewitt, C. Gordon, Dominion Entomologist, Ottawa, Canada.
High, M. M., U. S. Bureau of Entomology, Kingsville, Texas.
Hinds, W. E., Agricultural Experiment Station, Auburn, Ala.
Hine, J. S., Ohio State University, Columbus, Ohio.
Hodgkiss, H. E., Agricultural Experiment Station, Geneva, N. Y.
Holland, W. J., Carnegie Museum, Pittsburgh, Pa.
Holloway, T. E., U. S. Bureau of Entomology, Audubon Park, La.
Hooker, W. A., States Relation Service, Washington, D. C.
Hopkins, A. D., U. S. Bureau of Entomology, Washington, D. C.
Houghton, C. O., Agricultural Experiment Station, Newark, Del.
Houser, J. S., Agricultural Experiment Station, Wooster, Ohio.
Howard, C. W., Christian College, Canton, China.
Howard, L. O., U. S. Bureau of Entomology, Washington, D. C.
Hungerford, H. B., University of Kansas, Lawrence, Kan.
Hunter, S. J., University of Kansas, Lawrence, Kan.
Hunter, W. D., U. S. Bureau of Entomology, Washington, D. C.
Hyslop, J. A., U. S. Bureau of Entomology, Washington, D. C.
Jennings, A. H., U. S. Bureau of Entomology, Washington, D. C.
Johannsen, O. A., Cornell University, Ithaca, N. Y.
Johnson, S. A., Agricultural Experiment Station, Fort Collins, Colo.
Jones, P. R., 350 California St., San Francisco, Cal.
Kellogg, V. L., Stanford University, Cal.
Kelly, E. O. G., U. S. Bureau of Entomology, Wellington, Kan.
Kincaid, Trevor, University of Washington, Seattle, Wash.
King, J. L., Care Economic Zoölogist, Harrisburg, Pa.
Kotinsky, J., U. S. Bureau of Entomology, Washington, D. C.
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Zappe, Max P., Agricultural Experiment Station, New Haven, Conn.

FOREIGN MEMBERS

Anderson, T. G., Nairobi, British East Africa.
Ballou, H. A., Imperial Department of Agriculture, Barbados, West Indies.
Berlese, Dr. Antonio, Reale Stazione di Entomologia Agraria, Firenze, Italy.
Bordage, Edmond, Directeur de Musée, St. Denis, Reunion.
Carpenter, Dr. George H., Royal College of Science, Dublin, Ireland.
Cholodkosky, Prof. Dr. N., Militär-Medicinische Akademie, Petrograd, Russia.
Collinge, W. E., 55 Newhall Street, Birmingham, England.
Danysz, J., Laboratoire de Parasitologie, Bourse de Commerce, Paris, France.
DeBussy, L. P., Deli, Sumatra.
Enock, Fred, 42 Salisbury Road, Bexley, London, S. E., England.
Escherisch, K., Forstliche Versuchsaustalt, Universitat, Munich, Germany.
French, Charles, Department of Agriculture, Melbourne, Australia.
Froggatt, W. W., Department of Agriculture, Sydney, New South Wales.
Fuller, Claude, Department of Agriculture, Peitermaritzburg, Natal, South Africa.
Gillanders, A. T., Alnwick, Northumberland, England.
Goding, F. W., Guayaquil, Equador, South America.
Grasby, W. C., 6 West Australian Chambers, Perth, West Australia.
Green, E. E., Royal Botanic Gardens, Peradeniya, Ceylon.
Helms, Richard, 136 George Street, North Sydney, New South Wales.
Herrera, A. L., Calle de Betlemitas, No. 8, Mexico City, Mexico.
Horvath, Dr. G., Musée Nationale Hongroise, Budapest, Hungary.
Jablonowski, Josef, Entomological Station, Budapest, Hungary.
Kourdumuff, N., Opytnoe Pole, Poltava, Russia.
Kulagin, Nikolai M., Landwirtschaftliches Institut, Petrooskoje, Moskow, Russia.
Kuwana, S. I., Imperial Agricultural Experiment Station, Nishigahara, Tokio, Japan.
Lea, A. M., National Museum, Adelaide, South Australia.
Leonardi, Gustavo, R. Scuola di Agricoltura, Portici, Italy.
Lounsbury, Charles P., Department of Agriculture, Pretoria, Transvaal, South Africa.
Mally, C. W., Department of Agriculture, Cape Town, South Africa.
Marchal, Dr. Paul, 16 Rue Claude-Bernard, Paris, France.
Mokshetsky, Sigismond, Musée d'Histoire Naturelle, Simferopole, Crimea, Russia.
Mussen, Charles T., Hawkesbury Agricultural College, Richmond, New South Wales.
Nawa, Yashushi, Entomological Laboratory, Kyomachi, Gifu, Japan.
Newstead, Robert, University School of Tropical Medicine, Liverpool, England.
Porchinski, Prof. A., Ministère de l'Agriculture, Petrograd, Russia.
Porter, Carlos E., Casilla 2352, Santiago, Chili.
Pospielow, Dr. Walremar, Station Entomologique, Rue de Boulevard, No. 9, Kiew. Russia.
Reed, Charles S., Mendoza, Argentine Republic, South America.
Ritzema Bos, Dr. J., Agricultural College, Wageningen, Netherlands.
Rosenfeld, A. H., Estacion Experimental Agricola, Tucuman, Argentina.
Sajo, Prof. Karl, Gödöllö-Veresegyház, Hungary.

Schoyen, Prof. W. M., Zoölogical Museum, Christiania, Norway.
Severin, Prof. G., Curator Natural History Museum, Brussels, Belgium.
Shipley, Prof. Arthur E., Christ's College, Cambridge, England.
Silvestri, Dr. F., R. Scuola Superiore di Agricoltura, Portici, Italy.
Theobald, Frederick V., Wye Court, Wye, Kent, England.
Thompson, Rev. Edward H., Franklin, Tasmania.
Tryon, H., Queensland Museum, Brisbane, Queensland, Australia.
Urich, F. W., Victoria Institute, Port of Spain, Trinidad, West Indies.
Vermorel, V., Station Viticole, Villefranche, Rhone, France.

JOURNAL

OF

ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

VOL. 11 FEBRUARY, 1918 No. 1

Proceedings of the Thirtieth Annual Meeting of the American Association of Economic Entomologists

The thirtieth annual meeting of the American Association of Economic Entomologists was held in Assembly Hall, Carnegie Museum, Pittsburgh, Pa., December 31, 1917, to January 2, 1918, inclusive.

The first session was held at 10.00 a. m., December 31, when the annual reports were submitted and the address of the President was given.

The meeting of the Section on Apiculture was held at 8.00 p. m., December 31.

The meeting of the Section on Horticultural Inspection was held at 1.30 p. m. and at 8.00 p. m., January 1, at Carnegie Museum.

The business proceedings of the Association are given as Part I of this report and the addresses, papers and discussion appear as Part II.

The proceedings of the sections were prepared by the sectional secretaries and are published as a part of this report.

PART I. BUSINESS PROCEEDINGS

The meeting was called to order by President R. A. Cooley at 10.00 a. m., Monday, December 31, 1917. About 100 members and visitors attended the sessions. The following members were present:

Ainslie, C. N., Sioux City, Iowa.
Ainslie, George G., Knoxville, Tenn.
Backus, H. E., Northeast, Pa.
Aldrich, J. M., West Lafayette, Ind.
Ball, E. D., Madison, Wis.
Barnes, P. T., Harrisburg, Pa.
Bentley, G. M., Knoxville, Tenn.
Bilsing, S. W., College Station, Texas.
Bishopp, F. C., Dallas, Texas.
Burgess, A. F., Melrose Highlands, Mass.
Cooley, R. A., Bozeman, Mont.
Cotton, E. C., Columbus, Ohio.
Creel, C. W., Forest Grove, Ore.
Davis, J. J., West Lafayette, Ind.

Dean, George A., Manhattan, Kan.
Dietz, H. F., Washington, D. C.
Eckert, J. E., Raleigh, N. C.
Eddy, M. W., State College, Pa.
Ewing, H. E., Ames, Iowa.
Felt, E. P., Albany, N. Y.
Fenton, F. A., Columbus, Ohio.
Flint, W. P., Springfield, Ill.
Forbes, S. A., Urbana, Ill.
Fulton, B. B., Geneva, N. Y.
Garman, Philip, College Park, Md.
Gentner, L. G., Madison, Wis.
Glenn, P. A., Urbana, Ill.
Goodwin, W. H., Harrisburg, Pa.
Gossard, H. A., Wooster, Ohio.
Guyton, T. L., Wooster, Ohio.
Hadley, C. H., State College, Pa.
Hartzell, F. Z., Fredonia, N. Y.
Headlee, T. J., New Brunswick, N. J.
Hine, J. S., Columbus, Ohio.
Holland, W. J., Pittsburgh, Pa.
Houser, J. S., Wooster, Ohio.
Howard, L. O., Washington, D. C.
Howard, N. F., Madison, Wis.
Hunter, S. J., Lawrence, Kan.
Jones, T. H., Baton Rouge, La.
Kellogg, V. L., Stanford University, Cal.
King, J. L., Harrisburg, Pa.
Kirk, H. B., Harrisburg, Pa.
Kisliuk, Max, Clarksville, Tenn.
Knull, J. N., Harrisburg, Pa.
Lovett, A. L., Corvallis, Ore.
McConnell, W. R., Carlisle, Pa.
Metcalf, C. L., Columbus, Ohio.
Morrill, A. W., Phoenix, Ariz.
Morrison, Harold, Washington, D. C.
O'Kane, W. C., Durham, N. H.
Osborn, Herbert, Columbus, Ohio.
Packard, C. M., Martinez, Cal.
Parker, R. R., Bozeman, Mont.
Peairs, L. M., Morgantown, W. Va.
Peterson, Alvah, New Brunswick, N. J.
Pierson, C. J., College Park, Md.
Primm, J. K., Philadelphia, Pa.
Rea, G. H., Harrisburg, Pa.
Reese, C. A., Charleston, W. Va.
Ruggles, A. G., St. Paul, Minn.
Rumsey, W. E., Morgantown, W. Va.
Sams, C. L., Raleigh, N. C.
Sanders, J. G., Harrisburg, Pa.
Sasscer, E. R., Washington, D. C.
Satterthwait, A. F., Lafayette, Ind.
Schoene, W. J., Blacksburg, Va.
Shaw, N. E., Columbus, Ohio.
Sherman, Franklin, Jr., Raleigh, N. C.
Stear, Jacob R., Wooster, Ohio.
Stearns, L. A., Alma, Mich.
Swenk, M. H., Lincoln, Neb.
Trimble, F. M., Primos, Pa.
Webster, R. L., Ames, Iowa.
Weigel, C. A., Columbus, Ohio.
Whelan, Don B., East Lansing, Mich.
Woglum, R. S., Alhambra, Cal.

President R. A. Cooley: You will please come to order. The first business on the program is the report of the Secretary.

REPORT OF THE SECRETARY

The total membership of the Association at the time of the last annual meeting was 466, divided as follows: active 134, associate 282, and foreign 50. At that meeting one associate member resigned and twelve were transferred to active membership. During the year one active and thirteen associate members have been dropped from the rolls, and two associate members have died.

The present membership totals 501, divided as follows: active 145, associate 306, and foreign 50. The net gain for the year has been 35 members.

On February 24, 1917, Mr. Francis Windle died at his home at West Chester, Pa. He had been a member of the Association for a number of years, had attended several of the meetings, and was greatly interested in entomology and natural history in all its branches.

In November, 1916, Mr. E. B. Reed, an associate member, died at Victoria, British Columbia. Mr. Reed had been for many years a member of this Association and was highly respected by all who knew him.

The Pacific Slope Branch of the Association held its annual meeting at Stanford University, California, April 5 and 6, 1917, 37 members and visitors being present. The meeting was very successful and the proceedings were published in full in the June number of the JOURNAL OF ECONOMIC ENTOMOLOGY.

In the last annual report the Secretary stated that the condition of the finances of the Association was such that the publication of the Index of American Economic Entomology could be undertaken if a reasonable number of advance subscriptions could be secured. At that meeting it was voted that the publication of the Index be placed in the hands of the editorial board of the JOURNAL OF ECONOMIC ENTOMOLOGY.

Owing to the rapid increase in the cost of publishing, it was deemed wise for the board to fix the subscription at a rate which would enable the work to be published without involving the Association financially. It was therefore decided that the Index be furnished to members of the Association, who subscribed before April 10, at the rate of $4.00 a copy, and that after that time the price would be fixed at $5.00 a copy for domestic subscriptions and $5.50 for subscriptions forwarded to foreign countries. The advanced subscriptions received were sufficient to pay a portion of the cost of publication, but it was necessary to transfer $500.00 from the treasury of the Association at the time the book was printed in order to pay cash for the publication. The financial statement shows that $200.00 of the amount borrowed has been returned to the Association treasury and a balance of $15.51 remains to the credit of the Index fund. Future sales should make it possible to pay back the $300.00 outstanding, and in time a small surplus may be accumulated to meet part of the expense of publishing a later volume, should the Association decide to continue this work.

THE JOURNAL OF ECONOMIC ENTOMOLOGY

The JOURNAL has had a reasonably successful year, although the increased cost of everything which goes to make up a publication has materially reduced the balance over that which was reported last year.

During 1917, the six issues have embraced 572 pages, which is approximately the same as the number published the year before.

The number of subscriptions have not changed materially from those received in 1916, but many of the collections have been very slow, this being particularly true on foreign orders.

The advertising in the JOURNAL is gradually decreasing,—hence the income from this source is not large at the present time.

Unless the number of subscriptions is very materially increased during the coming year, or the number of printed pages reduced, it will be necessary to increase the price of the publication if it is to be self-supporting.

In view of the fact that a considerable number of papers are published each year in the JOURNAL which are contributed by non-members of the Association, and that it is necessary, in some cases, to hold articles submitted by members for several months before they can be published, it is suggested that during the present emergency it might be well to publish only such papers as are presented by members.

ASSOCIATION STATEMENT

Balance in Treasury, December 20, 1916		$777.75
By amount received from dues, 1917		198.50
By amount received from interest in Melrose Savings Bank		6.10
By amount received from interest in Malden National Bank		9.87
To stenographic report 1916 meeting	$60.00	
Buttons, 1916 meeting	10.50	
Postage	52.20	

Printing programs, etc.	$45.85	
Telegraph and express	.56	
Miscellaneous supplies	1.08	
Transfer cases	5.60	
Drawing seal	10.00	
Pacific Slope Branch	9.80	
Committee on Entomological Investigations	22.76	
Transfer to Index Fund	300.00	
One $100 4% Liberty Bond	100.00	
Clerical work, Secretary's office	35.00	
One-half salary of Secretary	50.00	
	$703.35	
Balance, December 7, 1917	588.87	
	$1,292.22	$1,292.22

Balance deposited as follows:

Melrose Savings Bank	$157.42
Malden National Bank	431.45

JOURNAL STATEMENT

Balance in Treasury, December 21, 1916		$646.87
By amount received for subscriptions, advertising, etc., 1917		2,187.97
To stamps and stamped envelopes	$39.29	
Express	1.06	
Printing	2,128.83	
Halftones	172.28	
Miscellaneous supplies	14.00	
Insurance on JOURNALS in stock	18.75	
Clerical work, Editor's office	70.00	
Clerical work, Secretary's office	60.00	
Salary, Editor	100.00	
One-half salary of Secretary	50.00	
	$2,654.21	
Balance, December 7, 1917	189.27	
	$2,843.48	$2,843.48

Deposited in Malden National Bank $189.27

INDEX STATEMENT

By amount received from sale of Index		$928.50
By amount transferred from Association Treasury		300.00
To postage and express	$26.48	
Printing circulars	7.25	
Printing Index	1,105.06	
Clerical work and proof reading	57.20	
Insurance on stock on hand	17.00	
	$1,212.99	
Balance, December 7, 1917	15.51	
	$1,228.50	$1,228.50

Deposited in Malden National Bank $15.51

Summary

Balance on Index Account	$15.51
Balance on Journal account	189.27
Balance on Association account	588.87
One 4% Liberty Bond	100.00
	$893.65

Deposited in Melrose Savings Bank $157.42
Deposited in Malden National Bank 636.23

Respectfully submitted,

A. F. Burgess, *Secretary.*

On motion, the report was accepted and the financial part referred to the auditing committee.

President R. A. Cooley: The next item on the program is the report of the executive committee. This committee has not held a meeting during the year, and there is therefore no business of importance to report. I will now call for the report of the employment bureau, which will be read by the secretary.

REPORT OF ENTOMOLOGISTS' EMPLOYMENT BUREAU FOR 1917

December 26, 1917.

The Entomologists' Employment Bureau seeks to interest and help in the most impartial and impersonal manner possible both employers and employees in the field of entomology. The policy of the Bureau under the present administration is simply to bring together candidates seeking positions in various phases of entomological work and those employers who are responsible for the recommendations or appointments to such positions. When information concerning a possible position comes to the attention of the Bureau, it has been the practice to furnish to the employer a list of several names of such men as appear from their enrollment blanks to be best fitted for the position in question and possibly available for the appointment. An abstract of the principle points given on the enrollment blank with the names of parties to whom the candidate refers for additional information is furnished the employer for each name. It is expected that the employer should then select and communicate with such candidates as he desires to investigate further. Notice is also sent to each candidate whose name has been thus used, advising him to get into communication with the employer and learn full details regarding the position and present complete and up-to-date information regarding his own qualifications for appointment.

During the calender year 1917, 12 new names have been enrolled in the Bureau. Seven former members have re-inrolled during the year. Six other men have received the total of 10 references offered by the Bureau for the enrollment fee of $2. These men have been notified but as yet we have received no reply from them. The total number of the roll at present is 65.

Information has come to the Bureau regarding 24 openings, and among these 4 men suggested by the Bureau have been definitely placed with several more from which we have not yet heard because of neglect on the part of the candidate, no doubt, and of recent notifications. Two hundred and eleven names have been suggested to these possible employers for their further consideration and selection

of such candidates as seem to be best fitted for the particular work desired. Nearly 500 letters have been sent out during the year.

Financial statement of the Bureau is presented herewith:

	Dr.	
Cash on hand January 1, 1917	$57.55	
To 19 enrollment fees at $2	38.00	
Total receipts		$95.55
	Cr.	
February 9, 400 blank forms and printed (voucher 1)	$1.96	
May 1, Stenographic work (voucher 2)	15.00	
December 26, to 425 envelopes (voucher 3)	2.25	
December 26, to stamps (voucher 4)	9.24	
December 26, Stenographic work (voucher 5)	20.00	
Total		48.45
Balance on hand December 26, 1917		$47.10

W. E. HINDS, *In Charge.*

On motion, the report was accepted and the financial part referred to the auditing committee.

PRESIDENT R. A. COOLEY: I will now call for the report of the committee on nomenclature.

SECRETARY A. F. BURGESS: Prof. Herbert Osborn, chairman of the committee, wished me to state that it was impossible for him to be present at this session on account of another engagement. He asked me to say that no names had been submitted to the committee for consideration during the past year, and that the committee had no formal report to make.

PRESIDENT R. A. COOLEY: The next on the program is the report of the committee on entomological investigations.

SECRETARY A. F. BURGESS: No report has been received from this committee other than the one that was mimeographed and sent to all the members of the Association early in December. I infer that the committee feels that this was the only report that it was necessary to make.

By vote of the Association, the report was adopted.

PRESIDENT R. A. COOLEY: I will now call for the report of the committee on entomological work at the U. S. National Museum.

REPORT OF COMMITTEE ON NATIONAL MUSEUM

This committee appointed at our last annual meeting has been active the past year studying conditions in the U. S. National Museum for the purpose of offering means for promoting and providing for adequate development of the insect collections. Data on the existing conditions have been obtained with a view to determining practical means of assistance and coöperation which could be supported by this Association, as a whole or as individuals, in the development of the entomological work.

This committee therefore offer the following suggestions.

1. It is evident that the space allotted to the Division of Insects is insufficient for the proper handling of the great mass of material received for study and determination. The present crowded conditions materially decreases the efficiency of the staff.

2. The present staff is insufficient to handle the material received for determination and to remedy this difficulty the Division of Insects should be allotted much larger funds, not only for the enlargement of the staff of systematic workers but also for the purpose of purchasing valuable collections when they are obtainable only by purchase.

3. Entomologists studying certain groups are urged to furnish the National Museum with types or cotypes of species described by them as well as duplicate representatives of groups being worked up, and to coöperate with the Museum authorities in every possible way, thus enabling our National Museum to be truly national in scope and representative of the American continent.

4. Most of our serious introduced insect pests were not recognized until after they had become well established. The great importance of being able to obtain immediate determinations of unknown insects discovered in this country is evident to every entomologist who has followed the course of introduced species. We therefore believe that this institution should have a collection not only thoroughly representative of American insects, but an almost equally complete series of exotic species, particularly of the palearctic fauna, since commercial activities mean numerous introductions from other countries, and among these, as experience has shown in the past, there are bound to be some very destructive pests.

5. We suggest that our members employ every opportunity to impress persons in authority with the fact that the development of economic entomology in this country makes it imperative that the systematic work upon insects be developed to a corresponding degree, since correct identification is a fundamental to satisfactory control and to urge support for the Division of Insects of the U. S. National Museum. Although present war conditions make it difficult to secure increased funds, your committee feels that now, more than ever before, greater support should be given. Since the value of this work as a coördinate part of economic entomology is vital and since insect control is so essential in the great movement for increased food production, this expansion is of utmost importance.

Respectfully submitted,

JOHN J. DAVIS,
R. L. WEBSTER,
HERBERT OSBORN,
E. D. BALL,
E. P. FELT,
Committee.

By vote of the Association, the report was accepted and the recommendations adopted.

PRESIDENT R. A. COOLEY: I will now appoint the committees.

Committee on Auditing: T. J. Headlee, A. G. Ruggles.

Committee on Resolutions: E. D. Ball, W. C. O'Kane, F. C. Bishopp.

Committee on Nominations: Herbert Osborn, W. A. Morrill, W. J. Schoene.

PRESIDENT R. A. COOLEY: Is there any new business?

MR. J. G. SANDERS: I would like to present a proposed amendment to the constitution relative to membership. The draft which I have

here provides for replacing the classes of active and associate membership with three classes, namely: honorary fellows, fellows and members. As this matter must be referred to a committee for consideration, I would like to present it at this time so that the committee can be appointed and bring in their recommendations in order that action may be taken at the next annual meeting. I move that a committee of three be appointed for this purpose.

By a vote of the Association the President was instructed to appoint the committee.

PRESIDENT R. A. COOLEY: If there is no further business, the President's address will now be given. I notice that one of our oldest past Presidents is present at the meeting, and I will therefore ask Dr. S. A. Forbes to preside.

MR. S. A. FORBES: We will now have the annual address of the President.

At the conclusion of the address, Dr. Forbes stated that the discussion would be deferred until the afternoon session.

At the close of the session the following committee was appointed to consider the proposed amendment to the constitution: E. P. Felt, W. C. O'Kane, and J. G. Sanders.

At the afternoon session, Mr. Herbert Osborn stated that a matter had come up before Section F of the American Association concerning the bibliography of entomology. The following resolution had been offered in that section which he presented to the Association for consideration and action:

Resolved, That in the opinion of the American Association of Economic Entomologists, it is important that any plans formulated or encouraged by the American Association for the Advancement of Science looking toward the organization and advancement of national or international bibliographic projects, the existing international bibliographic undertaking for zoölogy, the Concilium Bibliographicum, Zurich, Switzerland, long approved by the American Association and in part supported by numerous grants from its funds, be kept definitely in mind and included in any plans for bibliographic work.

By vote of the Association the resolution was approved.

At the session held Tuesday morning, it was voted that the committee on resolutions be instructed to prepare an appropriate resolution relative to the attitude of this Association and the availability of its members for war service. It was voted that a committee of three be appointed by the President to bring these resolutions to the attention of the federal authorities. At the close of the session, the President appointed the following committee: S. A. Forbes, E. P. Felt, and W. C. O'Kane.

At the final session, Wednesday afternoon, January 2, the closing business of the Association was transacted.

PRESIDENT R. A. COOLEY: I will now call for the report of the committee on auditing.

REPORT OF THE AUDITING COMMITTEE

We, the undersigned, your committee on audit, hereby certify that we have examined the bills and accounts of your secretary covering income and expenditures from the Association, the JOURNAL and from the Index—also the accounts of the Employment Bureau—and that we believe the same to be correct.

Signed THOMAS J. HEADLEE,
A. G. RUGGLES,
Committee.

By vote of the Association, the report was accepted and adopted.

PRESIDENT R. A. COOLEY: I will call next for the report of the committee on resolutions.

MR. E. D. BALL: The resolution relative to war service was drafted by the committee with the assistance of Mr. Herbert Osborn and Mr. E. P. Felt.

REPORT OF THE COMMITTEE ON RESOLUTIONS

We, the members of the American Association of Economic Entomologists, wish o express by this resolution our deep desire to be of every possible service to the ation in the war. Whatever duty may fall to us we shall consider it an honor and a rivilege to perform.

We are deeply conscious of the complex problems and difficulties that have fallen o those on whom the direction of the war must rest; and we wish further to express ur appreciation of the extraordinary achievement already won in mastering these lifficulties and in solving these problems.

As a loyal body of American citizens we are eager to assist in meeting such special roblems as our technical knowledge and training may help to solve. It is our hope, herefore, to offer in fullest degree the technical services of our individual members. This we feel to be of great moment because of the vital bearing of expert entomological nowledge on certain serious phases of camp sanitation, especially in the prevention of the insect-borne diseases, including typhus and cholera, that have exacted severe toll in all wars, including the present struggle, and in the conservation of perishable supplies belonging to the army.

For this service it is our privilege to offer a body of men who have had a practical, definite and thorough training, that should render especially valuable their efforts as members of our national army—a training fully equal, we believe, to that of the corps of entomologists who are now rendering identical and signal service in the armies of our allies.

It is not our thought to propose by this resolution a specific classification or other plan of that nature; but rather to express our earnest wish to be of the utmost help, and to offer at this time a service which we believe and trust should be of genuine and special value.

Resolved, That the thanks of the Association be extended to the Carnegie Institute of Technology for the use of its buildings and apparatus and for the freedom of the

Museum and its valuable collections and especially to Dr. W. J. Holland for the many personal courtesies extended to the visiting entomologists.

E. D. Ball,
W. C. O'Kane,
F. C. Bishopp,
Committee.

By vote of the Association, the report was accepted and the recommendations adopted.

President R. A. Cooley: We will next listen to the report of the committee on membership.

REPORT OF COMMITTEE ON MEMBERSHIP

Your committee begs leave to report an increasing number of applications for associate membership in our association. Most careful consideration has been given to our recommendation for elevation of associate members to active rank, keeping in mind the value and extent of their economic entomological activities without being too greatly influenced by publications. Many associate members are so situated that facilities for personal publication are limited.

The committee recommends the elevation to active rank of the following associate members:

George G. Ainslie, Knoxville, Tenn.
George G. Becker, Fayetteville, Ark.
Donald J. Caffrey, Hagerstown, Md.
B. R. Coad, Tallulah, La.
E. N. Cory, College Park, Md.
C. W. Creel, Forest Grove, Ore.
Norman Criddle, Treesbank, Manitoba.
S. S. Crossman, Melrose Highlands, Mass.
W. P. Flint, Springfield, Ill.
M. M. High, Brownsville, Tex.
T. E. Holloway, Audubon Pk., La.
H. B. Hungerford, Lawrence, Kans.
J. L. King, Harrisburg, Pa.
H. O. Marsh, Rocky Ford, Colo.
Robert Matheson, Ithaca, N. Y.
W. R. McConnell, Carlisle, Pa.
Z. P. Metcalf, W. Raleigh, N. C.
Wm. Moore, St. Anthony Park, Minn.
G. E. Sanders, Annapolis Royal, N. S.
T. E. Snyder, Bureau of Entomology, Washington, D. C.
J. D. Tothill, Fredericton, New Brunswick.
T. D. Urbahns, Martinez, Cal.

The following are recommended for associate membership:

Ransom P. Allaman, Bedford, Pa.
R. H. Allen, Boston, Mass.
George Felix Arnold, Starkville, Miss.
Eric William Atkins, Station A, Ames, Iowa.
Floyd F. Bondy, Tallulah, La.
W. H. Brittain, Truro, Nova Scotia.
Dr. A. E. Cameron, Entomological Branch, Ottawa, Canada.
Wm. B. Cartwright, Knoxville, Tenn.
T. P. Cassidy, Tallulah, La.
Stewart C. Chandler, Carbondale, Ill.
L. H. Day, Hollister, Cal.
Dwight M. DeLong, Columbus, O.
Mack G. Dyess, Tallulah, La.
J. E. Eckert, Raleigh, N. C.
G. F. Ferris, Stanford University, Cal.
Anson L. Ford, Wellington, Kan.
Harold M. Fort, 201 College Ave., Columbia, Mo.
Stanley B. Freeborn, Univ. of Calif., Berkeley, Cal.
Stuart W. Frost, 119 Grove St., Tarrytown, N. Y.
Gwynn L. Garrison, Tallulah, La.
Samuel A. Graham, St. Anthony Park, Minn.
Geo. P. Gray, Univ. of Calif., Berkeley, Cal.
L. C. Griffith, Ithaca, N. Y.

Thomas L. Guyton, Ohio Agr. Exp. Sta., Wooster, O.
M. C. Hall, Detroit, Mich.
J. C. Hamlin, El Paso, Texas.
H. J. Herman, Falls City, Neb.
Albert Hartzell, Ames, Iowa.
F. B. Herbert, Los Gatos, Cal.
W. W. Henderson, Agr. Exp. Sta., Logan, Utah.
Chris M. Hunt, Gainesville, Fla.
H. G. Ingerson, Bur. of Ent., Washington, D. C.
Edward Roger Jones, University Sta., Baton Rouge, La.
Josef N. Knull, Hummelstown, Pa.
Merton C. Lane, Forest Grove, Ore.
James M. Langston, Forest Grove, Ore.
Horace Wilton Lee, Tallulah, La.
George Walter Luster, Tallulah, La.
George Maheux, Dept. Agriculture, Quebec, Canada.
E. J. Newcomer, Portland, Ore.
Raymond C. Osburn, Columbus, Ohio.
Wallace Park, Ames, Iowa.
J. J. Pillsbury, Providence, R. I.
James K. Primm, Oak Lane, Pa.
George H. Rea, Harrisburg, Pa.
Chas. A. Reese, Charleston, W. Va.
William A. Ross, Vineland Sta., Ontario.
C. L. Sams, Raleigh, N. C.
E. M. Schalck, R. F. D. 9, Rockford, Ill.
Henry H. P. Severin, Univ. of Calif., Berkeley, Cal.
Chas. E. Smith, Muscatine, Iowa.
Harris Pearson Smith, Tallulah, La.
Marion R. Smith, Washington, D. C.
C. F. Stahl, Spreckels, Cal.
Jacob R. Stear, 439 N. Market St., Wooster, Ohio.
Louis A. Stearns, Alma, Mich.
Charles F. Stiles, State University, Lexington, Ky.
A. L. Strand, 319 S. Black Ave., Bozeman, Mont.
Knowles Clark Sullivan, Columbia, Mo.
M. C. Tanquary, Manhattan, Kan.
F. M. Trimble, Primos, Pa.
E. S. Tucker, Baton Rouge, La.
R. K. Vickery, Saratoga, Cal.
Stuart Cunningham Vinal, Amherst, Mass.
Francis M. Wadley, Wichita, Kan.
E. V. Walter, Ames, Iowa.
C. A. Weigel, Columbus, O.
R. W. Wells, Bozeman, Mont.
Webb R. Williams, Tallulah, La.
H. E. Woodworth, 2237 Carlton St., Berkeley, Cal.
Martin Tranthan Young, Tallulah, La.

It is recommended that the resignations of R. J. Kewley, H. A. Preston, C. W. Loveland and W. R. Thompson, be accepted.

It is recommended that the Secretary send one more notification to members in arrears informing them that failure to immediately meet their obligations to the Association will result in erasure of their names from our membership list.

Respectfully submitted,

J. G. SANDERS, *Chairman*,
J. J. DAVIS,
W. E. BRITTON,
Committee.

By vote of the Association, the report was adopted.

PRESIDENT R. A. COOLEY: The next report will be by the committee on index to economic entomology.

REPORT OF THE COMMITTEE ON THE PUBLICATION OF THE INDEX OF AMERICAN ECONOMIC ENTOMOLOGY

Action at the last annual meeting authorized the Editorial Board of the JOURNAL OF ECONOMIC ENTOMOLOGY to publish the Index of American Economic Entomol-

ogy, 1905–1914, by Dr. Nathan Banks, and fix the cost of the volume, the attendant expenses being estimated at $1,300 for an edition of 1,000 copies.

It was hoped to issue the index by April 1, but delays almost inevitable in a technical volume of this size, and the difficulty on the part of the printer in handling the work, prevented sending out copies till May 20 and on the twenty-second the index had been mailed to all advance subscribers.

The total cost of an edition of 1,000 copies, including the binding of 300 (the remainder to be held unbound till needed), was $1,212.99. The advance subscription rate, limited to members and to be accompanied by a remittance prior to April 10, was fixed at $4.00 and after that the price was advanced to $5.00 for domestic and $5.50 for foreign subscriptions. There were 161 copies sold to advance subscribers and 58 additional to others prior to December 7, the date the books closed. The receipts from sales amounted to $928.50, leaving a balance against the work of $284.49. Since then nine other copies have been sold and these accounts are still outstanding. The indebtedness of $284.49 will be more than covered within a year or two, it is expected, by sales of stock on hand.

The index was not issued until so late in the year that it did not seem advisable to take any active steps toward securing the compilation of subsequent literature, especially as it would probably include at least three years and might perhaps be extended to cover a five-year period. The consensus of opinion among the committee favors the five-year period, though it is possible that after that time it may be feasible to issue the index annually and then combine it into a general index covering three- or five-year periods. The compilation of subsequent issues can probably be arranged with the Bureau of Entomology and it would certainly seem that that organization was better suited than any other to undertake such work because of the imperative need of the best library facilities.

It is recommended that the committee on the index of American economic entomology be continued and authorized to arrange for the indexing of the literature from 1915 to 1919 with a view to its publication later by the Association.

Respectfully submitted,

E. P. FELT,
W. C. O'KANE,
W. E. BRITTON,
A. F. BURGESS,
W. E. HINDS,
Committee.

It was voted that the report be accepted and placed on file.

MR. T. J. HEADLEE: I think a good piece of work like this ought to have its bit of praise, and I want the committee to understand that the index is sincerely appreciated. I have used it constantly since it came out and have found it to be of great service.

PRESIDENT R. A. COOLEY: Is the advisory committee ready to report nominations for JOURNAL offices?

SECRETARY A. F. BURGESS: As far as I have been able to determine, only two members of the advisory board are present at this meeting,—Prof. Kellogg, who has left town, and Dr. Howard. No report has been filed and I presume no action has been taken. The Editor, Associate Editor and Business Manager of the JOURNAL must be elected at this time, as the terms of the present officers expire. Under

the circumstances, I presume this could be done by a nomination from the floor.

MR. HERBERT OSBORN: I move that the present officers be reëlected to fill these positions.

The motion was seconded and carried.

PRESIDENT R. A. COOLEY: The report of the committee on nominations is now in order.

REPORT OF COMMITTEE ON NOMINATIONS

Your committee on nominations begs leave to place in nomination the following names for the offices stated:

For President: Dr. E. D. Ball, Madison, Wis.;

For First Vice-President: Prof. W. C. O'Kane, Durham, N. H.;

For Second Vice-President (Pacific Slope Branch): Prof. G. P. Weldon, Sacramento, Cal.;

For Third Vice-President (Horticultural Inspection Section): Mr. E. C. Cotton, Columbus, Ohio;

For Fourth Vice-President (Apicultural Section): Prof. Franklin Sherman, Jr., Raleigh, N. C.;

For Secretary: Mr. A. F. Burgess, Melrose Highlands, Mass.;

For Member of Committee on Nomenclature: Dr. E. M. Patch, Orono, Me.;

For Member of Committee on Membership: Dr. T. J. Headlee, New Brunswick, N. J.;

For Member of Committee on Entomological Investigation: Prof. G. A. Dean, Manhattan, Kan.;

For Members of Council A. A. A. S.: Prof. H. A. Gossard, Wooster, Ohio;
Prof. R. A. Cooley, Bozeman, Mont.;

For Advisory Committee of Journal of Economic Entomology: Prof. P. J. Parrott;
Prof. V. L. Kellogg.

Respectfully submitted,

HERBERT OSBORN,
A. W. MORRILL,
W. J. SCHOENE,
Committee.

MR. E. P. FELT: I move that the report be adopted and that the Secretary be directed to cast the ballot for the nominees. Carried.

PRESIDENT R. A. COOLEY: I will therefore declare the members whose names have been read duly elected as officers for the ensuing year. Is there any miscellaneous business?

SECRETARY A. F. BURGESS: I have not heard any recommendation by the membership committee or any other committees in connection with the boys who are members of this Association who have gone to the war. A considerable number are in the United States army and navy, and we have several members who are soldiers in the allied armies. I would move that the dues of officers or enlisted men, members of this Association in the United States or allied armies or navies, be remitted until the close of the war. Carried.

Mr. S. J. Hunter: I would like to move that the Secretary be instructed to prepare an honor roll containing the names of our members who are in various lines of military service. Carried.

Secretary A. F. Burgess: The balance of funds in the hands of the Journal is considerably less than last year. This is largely due to increase in price of everything going into the make-up of the publication. If we continue to publish as much material next year as we have published this year and get no more subscribers, we will have a very small balance to the credit of the Journal fund, if any, at the end of the year. The election of new members, in many cases, does not favorably affect the finances of the Journal. If 60 new members are elected and 40 of them have previously taken the Journal, the income of the Journal for the 60 members is $10 less than it would be from income of the 40 non-members. The reason for this is that a non-member pays $2.50 a year to the Journal, while a member pays $2.50 a year, but $1.00 of this amount goes to the Association fund. I am not opposed to the election of new members. I thoroughly believe in it, but we should understand that a large increase in membership does not necessarily mean a corresponding increase in the financial resources of the Journal. At present, the receipts of the Association are about $500 a year and the expenditures approximately $300. This leaves a balance of about $200. I think it might be wise, under conditions as they exist at present, to permit a transfer, if necessary, of a reasonable amount of money from the Association to the Journal fund during the coming year. I hope the receipts will be sufficient to meet all expenses, but as we wish to pay cash for everything, action along this line would seem desirable.

It was voted that the Secretary be authorized to transfer, if necessary, not to exceed $200 from the Association fund to the Journal fund during the present calendar year.

Mr. E. P. Felt: I would like to bring up some points concerning this matter as they affect the Editor, who is supposed to bear the burden if manuscript is carried a month or a year longer than the writer thinks it ought to be. As matters now stand, either the Journal board must determine how much shall be printed or secure an expression of opinion from the Association. It is not one of the principal pleasures of the Editor to decline manuscripts, but during the past year it has been necessary to refuse what would make nearly 100 pages of printed matter, and there are still a few manuscripts which have not been published. The policy has been for the proceedings of the Association to take precedence over everything else. Consequently, few papers can appear until June or later. In the June issue I outlined in part what seemed a fairly logical basis to follow under

present conditions. If we restrict ourselves pretty largely to new matter, we can handle the most important papers, except unusually long communications. Papers, it seems to me, fall into two classes,—lengthy and detailed reports which should be published as bulletins, and shorter papers which are important and cannot be handled readily by agricultural experiment stations or other agencies.

MR. E. D. BALL: I think we often take a good piece of work and do not realize the benefit we derive from it. If there is a little error we do not forget to mention it, but we forget to mention the good things. I feel a very keen satisfaction and I have never heard any other expression in regard to the management of the JOURNAL and also of the Index of Economic Entomology. We are proud of them and I think our Editor outlined a very definite and logical policy in his editorial,—one that is eminently just, and I move that we agree with the sentiments which he has expressed and facilitate its accomplishment.

MR. W. J. SCHOENE: I would not like to see the JOURNAL increase in size. I think Dr. Felt's method of handling the matter is very logical. I have had a little experience as an editor and I have found that workers sometimes are inclined to publish experiments rather than results. We want results rather than the details of the work.

MR. T. J. HEADLEE: I agree with Dr. Felt's statements. I feel that the membership might help the Editor a great deal if it thoroughly understood or appreciated his position. My personal feeling is that the long article should be "tabooed," and that members ought not to send long articles to the JOURNAL. If it were not for the probable "pinch" that is ahead of us, I would be very much in favor of increasing the size of the JOURNAL, but under present conditions I would not suggest anything of the kind.

MR. E. P. FELT: I would like to ask if it is desired to keep the JOURNAL at approximately the same size during the coming year.

This was agreed to and the motion made by Mr. Ball was carried.

PRESIDENT R. A. COOLEY: We will now take up the fixing of time and place of the next meeting.

SECRETARY A. F. BURGESS: Professor Gossard, one of our representatives on the counsel of the American Association, has been obliged to leave early, but wished me to say that it had been decided by the council to settle the time and place of holding the next meeting or to dispense with the meeting if conditions made it necessary. He recommended that this matter be left with the executive committee of this Association.

It was voted that the matter be referred to the executive committee.

MR. E. D. BALL: I move that the executive committee be instructed

to transact the necessary business of the Association during any interim that may exist before another meeting. Carried.

MR. T. J. HEADLEE: The Ecological Society of America has appointed a committee to work out and define, if possible, the interrelationship of this Association and the Ecological Society, because they seem to believe that they could be of considerable aid to the economic entomologist. I have been asked to present this matter and suggest that a special committee be appointed to coöperate with the committee appointed by the Ecological Society.

By vote of the Association, the President was instructed to appoint this committee.

PRESIDENT R. A. COOLEY: I wish to announce that I have communicated with Dr. Forbes by telegraph, and he has accepted the chairmanship of the special committee to which he was appointed. I wish to express my personal appreciation of the hearty and enthusiastic work of the committees and the thorough coöperation of all the members in making the program a success.

Adjournment.

PART II—PAPERS AND DISCUSSIONS

THE PRESIDENT'S ADDRESS

ECONOMIC ENTOMOLOGY IN THE SERVICE OF THE NATION

By R. A. COOLEY, *Bozeman, Montana*

As we come together at this time on the occasion of the Thirtieth Annual Meeting of the American Association of Economic Entomologists two things are prominent in our minds: first, the fact of the great world war, and second, our desire to be of service to the nation. I have thought it desirable to review our status and to discuss economic entomology in the light of the national emergency, and in doing so I hope that what is said may be of interest to our Canadian as well as to our American entomologists. Necessarily, conditions in the United States will be discussed more particularly, but the underlying truths will be of wider application.

War, while most deplorable, is nevertheless a great teacher of lessons and may be a great impulse to progress. The needs of the nation as brought prominently to view by war, are but little different from those of peace, but they become intensified by the stress of the times and,

under the impulse of a national emergency, we may make, in a relatively short time, an amount of progress, which otherwise would require many years.

What are the lessons for the economic entomologist and how may we best apply them in this national emergency and also in the period following the war? May I say that in discussing this subject at this time I feel a considerable sense of responsibility and some misgiving. I am conscious that what I shall say may contain much that is old and little that is new. It seems perfectly clear, however, that such a discussion is desirable and can scarcely fail of being beneficial. We should not overlook the fact that economic entomology, although enjoying a rapid growth, is none the less incompletely organized, when the nation as a whole is considered. It is desirable that we should be willing, if necessary, to throw over any traditions that have served their purpose and in this grave hour approach new problems in the true spirit of science, with open-mindedness.

In the first place let us review briefly the facts which set forth the scope and importance of entomological service in the national welfare. They fall naturally under two general heads—agricultural entomology and medical entomology.

It is, of course, impossible to state with mathematical accuracy the amount of damage or loss to plants and animals or to plant and animal products through the attacks of insect pests. Without doubt the most comprehensive figures that have been given us are those of Mr. C. L. Marlatt, in his article in the Yearbook of the Department of Agriculture for 1904. The estimated total loss there given is $795,100,000. More recent figures by Professor Herrick of Cornell University in his "Insects of Economic Importance" place the loss in 1915 at $1,182,000,000, but since the value of agricultural products has increased so rapidly in recent years, and considering the present high prices, we are probably safe in placing the annual loss at the present time roughly at $1,400,000,000. Writers on this subject quite generally agree that the losses amount to at least 10 per cent of the total value of the crops. Thus wholly disregarding very large sums which entomologists have taught the farmer to save, possibly an additional 5 per cent, we are concerned, as a profession, with the saving of some $1,400,000,000 and at a time when 10 per cent of America's agricultural products might be enough to turn the balance in the war. It should further be pointed out that the losses occasioned by insects are to be deducted from the profits, and not from the gross returns, for the cost of producing a damaged crop is practically the same as of an undamaged one, excepting for a small extra item for harvesting the larger returns. This 10 per cent stands as our challenge. The great practical question is, can we by

special emergency efforts materially reduce this waste, or can the American people organize to accomplish this end?

Passing now to medical entomology we are concerned both with human life and health and with the economic welfare of our people, both of which are vital to the nation, in peace or in war. Dr. W. D. Hunter, in his scholarly address on medical entomology at our Cleveland meeting in 1913, summarized this subject for us and pointed out that, wholly in addition to the sickness, invalidism and deaths occasioned by diseases that are carried by insects and the human interest attached thereto, the nation suffers an annual economic loss of some $357,900,000. Here again the war emphasizes the importance of entomological service, and the conditions that obtain when man is about his ordinary pursuits are magnified many times over when army camps are established and when man power in civil life is in need of being conserved. We may place, then, a very high estimate on the value of the knowledge we possess concerning the insects which transmit diseases, as a factor in winning the war, as applied not only in the army but also in civil life.

Being actually confronted by a serious world shortage of foods and other necessary agricultural products, and with the allied nations looking to us to supply very largely what others lack, we find that the first and most urgent demand made upon us is in that branch of our service which we call extension entomology. Undoubtedly the next great forward step in economic entomology will be in this direction. In fact the change is already taking place. Some states have been making more than casual efforts in extension work and the passage of the Smith-Lever Act gave the movement a great impulse and was the first organized effort of national scope towards this end. Under this act, one by one, the states have been employing extension specialists in entomology. Since the opening of the war the Bureau of Entomology at Washington has been given a special emergency fund of $145,775 under the Food Production Act for extension or control work on insects. *This is especially gratifying since it will do much towards* saving crops, and is also very likely to be instrumental together with the Smith-Lever Act in bringing about, through the coöperation of federal and state authorities, the gradual establishment of a great national system through which a very large amount of effective extension work may be done. It is to be hoped that, once established, the system will be continued after the close of the war.

This whole movement is just now undergoing a very rapid evolution and it is of the greatest importance that while giving special attention to the present needs of the nation we do not overlook future needs but that we lay the foundations for a permanent extension system in ento-

mology. It is desirable also that during the period of the war, economic entomologists demonstrate in very practical ways the good that they can do for the nation. This will not only aid in winning the war but will at the same time furnish the reason for continuing the work. Thus the two interests are identical. As a nation we have not yet established the most effective organization of our official work in economic entomology. On the part of the states we have a greater variety of types of organization than is warranted by their needs. This applies more especially to the horticultural inspection work where we have in different states boards of agriculture, boards of horticulture, boards of entomology, state entomologists, either connected with the experiment station or not—all doing much the same class of service. Some states take a very active interest in the enforcement of inspection laws, while others show little interest. The United States Department of Agriculture has been following consistent and well conceived plans in its research work and the work of the Federal Horticultural Board, but as between the two,—the federal and the state agencies,—there has not been the fullest coördination.

The kind of organization of official entomology in the states has for the most part been determined by personalities and the personal wishes of those who were present in the state rather than in conformity to a nation-wide plan. I do not wish to be understood as advocating an effort at this time toward radical and rapid change of organizations though we may profit by observing plain principles of efficiency in any changes that may come up in the future, and it certainly is true that our profession would be better understood and of greater service if our organizations were less confusing to the public, to state officials, and even to ourselves. At any rate, now that we have the opportunity we will do well in setting up an extension organization to follow well formulated plans and to be as uniform as possible.

For the purpose of securing authentic information regarding the status of organized state extension work, especially that under the Smith-Lever Act, a questionnaire was addressed to the several states. This has elicited information, which is tabulated on page 20.

An examination of this table shows, and the replies and correspondence show more fully, a number of interesting and important conclusions.

(1) Extension entomology is not yet generally organized as a separate division, coördinate with teaching and experiment station work. Out of 48 states, 12 have organized or are now undergoing organization, 36 have not organized. A few states, while not organized in the sense intended in the questionnaire, are giving careful attention to extension and survey work. Under those states reported as not

EXTENSION ENTOMOLOGY UNDER THE SMITH-LEVER ACT

	Organized or not?	Extension Entomologist?	Member Ent. Dept.?	Directed by Ent. Dept. or Ext. Serv.?	Head of Dept. formally recognized by Ext. Serv.?	Head of Dept. informally consulted?	Special fund?	
Alabama	No	No	......	......	Yes	......	No	Some work done by State Entomologist
Arizona	No	No	......	......	No	Yes	No	Some work done by State Entomologist
Arkansas	No	No	......	......	No	Yes	No	Some work done by Extension Horticulturist
California	No	No	......	......	No	Yes	No	Some work done by other agencies
Colorado	No	No	......	......	No	......	......	Extension work being done, in part, informally through Extension Service
Connecticut	No	No	......	......	No	Yes	......	Some ext. work done by State Entomologist and some by Extension Service
Delaware	No	No	......	......	......	......	......	No Entomologist
Florida	No	No	......	......	......	......	......	State Plant Board doing extension work
Georgia	No	No	......	......	......	......	......	All work done by Horticultural Department
Idaho	No	No	......	......	No	Yes	......	Station Entomologist works with county agents
Illinois	......	No	......	......	......	......	......	Well organized under the Entomological Survey
Indiana	No	No	......	......	No	Yes	......	
Iowa	No	No	......	......	......	......	......	
Kansas	Yes	Yes	Yes	Both	Yes	......	No	
Kentucky	No	No	......	......	No	Yes	No	Some extension work done informally
Louisiana	No	No	......	......	......	......	......	
Maine	No	No	......	......	No	Yes	......	
Maryland	Yes	Yes	Yes	Both	No	Yes	No	Temporary emergency organization
Massachusetts	No	No	......	......	No	Yes	No	Extension work done informally. Slight amount of work done by other agencies
Michigan	Yes	Yes	Yes	Both	Yes	......	No	
Minnesota	No	No	......	......	No	Yes	No	State Entomologist and assistants do extension work
Mississippi	No	No	......	......	No	Yes	......	Some extension work done informally
Missouri	Yes	Yes	No	Extn. Serv.	No	Yes	Yes	
Montana	No	......	......	......	No	Yes	......	Organized under state entomologist fund
Nebraska	Yes	Yes	Yes	Both	Yes	......	No	
Nevada	No	No	......	......	No	Yes	......	
New Hampshire	No	No	......	......	Yes	......	No	Special control and education conducted by State Department of Agriculture
New Jersey	Yes	No	......	......	Yes	......	Yes	
New Mexico	No	No	......	......	......	......	......	Biologist in charge of work
New York	Yes	Yes	Yes	Both	No	Yes	Yes	Other agencies do some work
North Carolina	No	No	......	......	Yes	......	No	
North Dakota	No	......	......	......	......	......	......	Some work done by State Dept. of Agric.
Ohio	......	No	......	......	Yes	......	No	Extension work done by University Experiment Station and other agencies
Oklahoma	No	......	......	......	......	Yes	No	Extension work done informally
Oregon	......	Yes	No	Extn. Serv.	Yes	......	No	Extension entomology combined with plant pathology
Pennsylvania	Yes	Yes	No	Extn. Serv.	......	......	Yes	No entomology department in college
Rhode Island	No	No	......	......	......	Yes	No	
South Carolina	Yes	Yes	Yes	Ento. Dept.	Yes	......	Yes	
South Dakota	Yes	Yes	Yes	Both	No	Yes	Yes	
Tennessee	Yes	No	......	......	Yes	......	Yes	Head of department doing extension work without assistants
Texas	Yes	Yes	No	Extn. Serv.	No	Yes	Yes	
Utah	No	No	......	......	No	Yes	No	
Vermont	No	No	......	......	......	......	......	Some extension work done by other agencies
Virginia	No	No	......	......	No	Yes	No	Some extension work done by other agencies
Washington	No	No	......	......	Yes	......	No	Some extension work done by other agencies
West Virginia	No	No	......	......	No	Yes	No	
Wisconsin	No	No	......	......	No	Yes	No	Some work done by other agencies
Wyoming	No	No	......	......	No	......	No	No entomologist

organized are included several which have no official entomologists or have their pest control work done by biologists or zoölogists. States reported as not organized are in many cases doing extension

work in the old, informal way, generally on demand from the farmers or from official agencies of the state.

(2) With the exception of two states, those states reported as organized have extension entomologists. Thus there are reported 11 states having extension entomologists. Seven states report assistants to the extension entomologist of one sort or another.

(3) Of the 11 states reporting extension entomologists, 7 state that the man engaged in this work is a member of the entomology department while in 4 states he is not so connected.

(4) In all cases where the extension entomologist belongs to the extension organization and not to the entomology department he is under the direction of the extension service only. Where he is a member of the entomology department he is in all cases jointly directed by the head entomologist and the extension service, excepting in South Carolina, in which state he is wholly under the entomology department. When directed by both there is some variation as to his relationship to each.

(5) Several states did not answer the question relative to whether the head of entomology is formally recognized or informally consulted by the extension service. Of 35 reporting 11 state that the entomologist is so recognized, and 24 report that he is not. When not formally recognized he is generally informally consulted.

(6) In 8 states only is a special extension fund reported outside of salaries, but several report funds as needed from the extension service.

(7) Many states report more or less extension work being done by other agencies.

(8) In Georgia all such extension work is done by the horticultural department.

(9) In one state, Oregon, the work in both entomology and plant disease is being done by one extension man.

In the states we have not yet, in most cases, established the most effective organizations under the Smith-Lever Act. To be sure the extension organizations in the states are for the most part quite new but with the experience we have had already a number of reliable conclusions affecting entomology appear to be indicated.

As a step toward a further recognition of entomology under this act it is very desirable that entomologists themselves fully recognize the importance of this new development and that a form of organization which provides for the solution of various perplexing questions be outlined, and brought to the attention of the suitable officials in the states. Extension entomology urgently needs more than occasional or casual attention. Research and experimentation have gone far ahead of extension, and entomologists are in possession of a vast

amount of valuable information which the farmer does not have or which he imperfectly understands. The result is that losses continue which might be prevented and in many instances the farmer does not know even that his crops are being injured. Even now under emergency conditions there is a strong tendency to overlook average losses and pay attention only to conspicuous outbreaks of pests. The importance of this work, especially in view of the world shortage of food, clothing and other necessities, and the prospect for a long continued shortage in these staples, can scarcely be over-emphasized.

The work in the several states under the Smith-Lever Act has led to the appointment of a large and rapidly increasing number of county agents. This has greatly increased the demands for state work and has created an opportunity for definite constructive entomological work among the farmers. To carry on such work successfully there must first be the right kind of organization. It seems, therefore, that the logical and feasible first step is to establish extension divisions in the entomological departments connected with the land grant colleges. Wherever possible there should be extension entomologists in each state giving full time to the development of this work, unless the state has an effective way already inaugurated.

I do not wish to be understood as minimizing the control work that is being done in some states by organizations away from the land grant colleges, or under special appropriations by entomologists connected with such colleges but not articulated with the extension service. Where such work is being done it should be continued and encouraged, especially during the present emergency, but at the same time we should realize that the Smith-Lever Act recognizes, officially, only the land grant colleges in the several states and I believe it is through this new extension organization that an effective nationwide system may be built up.

In chronological order the next important step in the development of extension work is that being inaugurated at the present time by the Bureau of Entomology under the Food Production Act which was approved by the President August 19, 1917. This has already been mentioned above. Under this act the Bureau of Entomology has organized an Office of Extension Work in Entomology. Project agreements between the Bureau and the Extension Services of the several states are being entered into. These agreements provide for the placing of specialists from the Bureau in the states who will be directed coöperatively. These men are under the immediate direction of the extension services of the states where they are employed but the general plans will be as agreed upon between the state and federal authorities. A project to increase production in a given state or re-

gion or to carry out other provisions of the Food Production Act in other lines of agricultural work can, in most cases, be definitely planned in advance but insect outbreaks are often sporadic and always regional and the Bureau of Entomology reserves the right to detail the specialist to another state if a serious outbreak makes this necessary. It will strengthen the work in the various states if when the emergency has passed, the Bureau's specialist be returned to his original station.

Rather definite plans are, of course, needed on the part of the states in order that the fullest use of the Bureau's specialists may be made. A part of the work of the year can in most cases be laid out in advance and clearly it is desirable that any state, for the purposes of extension work to be done either in coöperation with the Bureau of Entomology or independently, should have definite information regarding the relative importance of the various crops grown in the state and regarding also the relative amounts of damage done by the different pests. Pest survey work is of the greatest importance in this connection. Only with such definite information before the entomologist, can the most useful work be undertaken.

The emergency extension work carried on by the Bureau of Entomology makes it more important than ever that each state should have its own extension entomologist. Mr. J. A. Hyslop, who has been charged with the direction of the extension office of the Bureau of Entomology, emphasizes this point in a recent letter in which he suggested that an extension entomologist should be appointed in every state, and that he should be the project leader in all coöperative entomological extension projects in that state. The great danger at the present time appears to be that the state will in many cases be content to stop with the securing of one of the Bureau's specialists. The federal specialist can be much more effective if he works in coöperation with the local man who is following a comprehensive plan for meeting the state's needs.

From every standpoint it is very desirable that the extension entomologist should be a member of the entomology department of the institution and that the head of the department have the closest relationship with the extension director in planning the extension work in entomology. The department can do much for the extension entomologist and for the state through him, and he in turn can do much for the department by keeping it in touch with the needs of the state. Teaching, research and extension may all be benefited by being coördinated through one head. However, some states have already organized with the extension entomologist independent of the department of entomology in the institution, and in one state at least the only connection which the entomology department has with the

extension work is through informal conferences. As a general principle the work of the land grant college in extension work should be the work of the departments, as in the case in both the experiment station and in the college, and not the work of an independent organization out of touch with the college departments. Others have stated this before me. The heads of departments should be a part of the extension organization or a part of an extension council in which general policies are discussed.

The fact that there are county agents in the field under the direction of a state leader and that these are the persons through whom, or in coöperation with whom, the specialist from the college does certain of his work, introduces a factor not found in the experiment station and for which special provision has to be made. Clearly the county agents must be coördinated through the state county agent leader and the specialist clearly must do his work with the agents through coöperation with the leader. The county agent has many duties to perform and what he does for or with the state specialists must bear an orderly relation to his other duties. The county agent necessarily does many things for the farmer on his own initiative or on request from the farmers and he must call upon the college departments for aid. Thus the initiative for new work may naturally come from the county agent, the county agent leader, or the state specialist. Clearly then there should be laid down an orderly procedure. The fullest usefulness can come only from the fullest coöperation and the fullest coöperation can come only through having a well understood and accepted channel of communication. Any initiative coming from the college should be the result of conference between the extension service and the college department and any communication with the county agent should be through the leader or with his knowledge in each specific case if any claims on the county agent's time are contemplated.

The plan in various states of having the extension service direct the time and the routing of the specialist is probably the best that can be devised but the departments alone should be responsible for the information and instructional programs which the specialist dispenses. Recommendations concerning titles and salaries should emanate from the department of entomology. The head of the department should take a very active interest in the success of the work in the field.

The extension entomologist has for his main object the saving of as much as possible of the 10 per cent loss of agricultural products. He has laid out before him a field of great opportunity and of great possibilities. He may work through the farmer himself or through the farmer's children in the schools. He may use lectures, circulars and the agricultural, weekly and daily press. He may conduct demon-

strations and prepare charts and exhibits. He may prepare elementary textbooks and in short he has an opportunity of building up a great system of public instruction. He will need enthusiasm and he should not only lead the farmer to see what he should do but get him to actually do it.

This program suggests a number of things that economic entomologists in general should do for the assistance of the extension entomologist. Among these I would mention what may be called standardization of methods of control. By this I mean the general and official adoption of uniform or standard methods of control for as many as possible of our insect pests, such standard methods to become the basis of systematic public instruction. I believe that one principal reason why we have not made greater progress in leading farmers to actually control more of the insect depredators is that we have lacked sufficient definiteness in our recommendations. One entomologist has recommended one thing and another has proposed a second while perhaps the more general practice has been to recommend several methods and leave the farmer to choose for himself. The result has been in too many cases that the farmer has tried none of them. We must remember that the farmer is not a specialist, let alone an entomological specialist. He is not prepared to decide between remedies. How can we expect him to do what we have failed to do? Yet if he does anything it must be something definite and he must have reasonable assurance that what he does will repay him for the time and money expended. He can reasonably ask this of us; we can afford to offer nothing less. I realize very fully that there are limitations to the idea of standard methods, and that I am liable to be misunderstood. The control of insect pests cannot be reduced to a rule of thumb, and yet I believe that we can do much to facilitate the work of the extension entomologist and of the farmer by making a beginning in what shall be a continuous effort toward bringing together such statements of control methods as the farmer can and will use. A standard control method may vary with the climate, number of brood and other known factors in different localities. Let me say that because there are at present few if any insects for which we have sufficiently definite information to enable us to set up standard control programs, is no reason why we cannot with fuller information set up such programs. There certainly is truth in the assertion that climatic and other conditions vary in different parts of the country and that correspondingly the life-histories and habits of insects and their responses to insecticides vary, but it is just as true that in many instances we have failed to work out the variations and have left the farmer in the dark. Most certainly our duty is to discover the effects of these varying factors

and to make them clear to the farmer. If extension entomology is to become more than a sporadic affair, and is to assume the proportions of a worthy national movement, we must show that the advice given will benefit the farmer in a very practical way. We do not make a consistent showing if under the same climatic conditions one state recommends one thing for the control of, say the apple leaf aphis, while the next state, under practically the same climatic conditions, recommends another or if a third state equally interested overlooks the insect altogether in its official publications.

I look upon the present movement in extension entomology as era making. Economic entomology as an abstruse science, out of vital touch with the needs of mankind, would have very little reason for continuing and the science will grow and develop in proportion as it meets human needs. Economic entomology in America has been practical, indeed very practical, but the time has come when we should make the taking of the products of research to the farmer a definite scientific enterprise.

Closely related to extension entomology is the special control work being done by entomologists under appropriation made to meet specific needs. The organization in the states most likely to be charged with conducting such work is the one best qualified to conduct it, but because of the style of organization and methods used there seems to be no reason why this may not be connected with the work of the extension entomologists or conducted with it coördinately through the head of the department. As rapidly as sufficiently definite information and special appropriations can be secured such special control projects should be started.

Some comments on research entomology are pertinent. I have said that we are in need of more definite practical information concerning the control of our common pests. To meet this need we shall in many cases have to go back and conduct many experiments and minor studies to clear up practical points. Men of wide experience should direct these studies. The more formal and fundamental studies of the research entomologist are if anything more urgently needed now than before and I would not in the least minimize projects under the Adams fund which generally require several years for their completion, yet we must recognize also that we need funds for less formal studies. The sporadic nature of insect outbreaks affects research work as well as extension and quite often problems which vitally affect the saving of crops, come up for solution suddenly and need immediate attention. We must, therefore, provide for flexibility in our plans.

In the present great national emergency we must be willing to do anything necessary within our power to increase the supply of

plant and animal products and we should be willing even to lay aside for a time our research work and meet emergencies. Without doubt our directing officials will approve. A safe rule to follow is to continue the old work unless there is a real reason for a change.

Law enforcement to prevent the introduction and spread of insect pests will probably be little affected by the movement in extension entomology other than the benefit that will result from a wider knowledge of insect pests. It should be said, however, that in view of the national and of the world conditions we should increase rather than slacken our efforts to prevent the dissemination of dangerous species. Growing out of the shortage of foods there has been an increasing tendency on the part of the public to demand a slackening in the inspection and quarantine regulations. International commerce has been revolutionized during the war and after the war is over still more extensive changes may follow. Just what the special needs of the hour will be then we cannot say now, but it is clear that the inspection service will be greatly needed.

During the period following the war, and in connection with the development of a national system of extension entomology now under way, it is probable that the teacher of entomology will find much to do. In the first place an increasing number of well trained men will be needed. From the present indications there is very little danger of overcrowding the profession. There is much more danger that there will be a serious shortage of suitably trained men during the next ten years. Naturally the demand will be not alone for extension entomologists, but for investigators, inspectors, directors of control projects under special appropriations and teachers as well. From the professional standpoint the outlook in entomology is very bright, and we should give renewed attention to the further development of means and methods in teaching entomology in the college and university.

Now as never before the entomological departments of our colleges and universities require at the head men who will give attention to the broader aspects of economic entomology. The time is passing when the narrow specialist who overlooks the needs of his state can continue to give satisfaction as an administrator. We need to give full attention to the development of what may be termed state systems of entomological service, and through the fullest joint coöperation between the United States Department of Agriculture and the states, develop a more effective nation-wide system. It is possible that a committee of this Association ought to work out a plan for taking definite steps to facilitate this. We need to submerge local interests and seek to promote first the general good in order that economic entomology may render the fullest service to the nation.

President R. A. Cooley: I will call on Mr. O'Kane to present his paper:

TAKING STOCK

By W. C. O'Kane, *Durham, N. H.*

(Withdrawn for publication elsewhere.)

President R. A. Cooley: I feel especially grateful to Professor O'Kane for this paper. It is before you for discussion.

Mr. H. A. Gossard: I feel very grateful to Mr. O'Kane for assembling this information, together with charts. I have no doubt that it represents a great deal of truth. I was wondering, however, if Professor O'Kane didn't feel sometimes as though he would like to turn aside his mathematical method of putting in those lines. For instance, suppose we come to such a question as gipsy moth control. If I were looking at the reports from an entomologist like Mr. Burgess, who had given a great deal of time to that insect, and to reports of two or three other entomologists, and I found those agreeing, I would certainly give more credit to them than I would if a hundred entomologists, with whose work I was unfamiliar, reported on that problem. The same thing would apply if I found Professors Davis and Forbes agreeing on a point: I would be inclined to accept these two judgments and not the ninety-eight judgments of some others. I am wondering if Professor O'Kane didn't find a few times when the consensus of opinion failed to represent the exact truth of entomological knowledge.

Mr. W. C. O'Kane: The majority of the entomologists left out the insects of which they had no personal knowledge. The replies concerning gipsy moth came from those states in which gipsy moth occurred and in which they had experience with it. The percentages are fixed on those that actually gave their experience with the insects. I confess to a feeling such as you have, precisely. I made out no chart myself and endeavored to leave myself out of it in tabulating and simply took, as you said, the volume.

Mr. S. J. Hunter: It seems to me that this is one of the most illuminating articles we could possibly have, coming after the President's address. If I get the tenor of it, when the President's address is carried into effect, the three lines: the dotted, dash and straight line will fuse. I expect to have these charts reproduced in large size and use them in my classes in entomology.

Mr. J. J. Davis: This certainly has been a very suggestive paper and much appreciated, but I feel exactly as Professor Gossard does, in that I don't believe it presents to us the true state of affairs as they exist.

Take, for instance, the Hessian fly. The farmer control of the Hessian fly was at zero. I have worked a little on the Hessian fly in the past year and I don't believe we can say that the actual control of the Hessian fly is as low as the zero point, and I can't understand how the questionnaires could have reproduced, if they were the actual state of affairs, a zero result in the control of the Hessian fly. We realize that it is lower than it should be, but how it could be zero is unbelievable.

MR. W. C. O'KANE: I said that nobody had complete control. Mr. Davis is right about the point he mentioned, and the dotted line, if the paper is published, should be very clearly made to indicate the opinion of entomologists as to complete control security; also partial control security, and I think that will be made clearer in the paper itself. As to actually securing complete control, everybody said we didn't get it.

PRESIDENT R. A. COOLEY: Do you wish to discuss the paper further? If not, we will adjourn.

Adjournment, 12.20 p. m.

Afternoon Session, Monday, December 31, 1917, 1.45 p. m.

PRESIDENT R. A. COOLEY: The first paper entitled "Texas Aphid Notes," by F. B. Paddock, will be read by Mr. Bilsing.

TEXAS APHID NOTES

By F. B. PADDOCK, *State Entomologist, College Station, Texas*

Upon a review of the literature on this family we find but few references to the aphids in Texas. In 1906 Sanderson[1] records some rearing notes on the European grain aphis, *Macrosiphum granaria* Buckt. The first paper on the economic phase of a Texas aphid was by Professor Webster in 1912[2] on The Spring Grain Aphis or "Green Bug." The next paper was in 1915 by the writer on the turnip louse.[3] From time to time in other publications the distribution of an aphid has included some portion of Texas. No List of Texas aphids has been published, although some material has been collected and a few notes have been made by some of the former entomologists of the Texas station. This group of insects has not attracted the attention of collectors passing through the state as have other groups, as Jassids, Orthoptera, Coleoptera, and Hymenoptera.

[1] Texas Notes II. E. Dwight Sanderson, *Macrosiphum granaria* Buckt. Entomological News, November (page 327), 1906.

[2] The Spring Grain Aphis or "Green Bug." Webster and Philips. Bureau of Entomology, Bulletin 110.

[3] The Turnip Louse. F. B. Paddock. Texas Station, Bulletin 180.

From the records that have been made and personal observations it would seem that the species of this family are not as abundant in Texas as in other states. This may be partly due to the natural factors, which will be mentioned later, but perhaps largely to the fact that sufficient work has not been done on the group. A few new species have already been found, and it is to be expected that future work will reveal the presence of other new species as well as more of the old species.

The fact that no considerable amount of work has been done on aphids should not be taken to indicate that this group of insects is not important in this state. As a matter of fact, the economy of this state is disturbed as much by the presence of aphids as in any other state. Among the destructive species that might be mentioned are the "green bug" *Toxoptera graminum* Rond., the melon or cotton louse, *Aphis gossypii* Glover, the turnip louse, *Aphis pseudo-brassicæ* Davis, the oat louse, *Aphis padi* Linn, and the corn-leaf aphis, *Aphis maidis* Fitch. The periodic losses by the green bug are very severe and are well known; the growing of melons and cucumbers have been abandoned in some sections on account of the melon louse, and the same is true of turnips and related plants subject to the attack of the turnip louse. Acres of oats are annually destroyed by the oat louse, although it is not appreciated that the loss is caused by this insect. Much corn (*Zea mays*) and sorghum are badly stunted every year by the corn-leaf aphis, although this condition of the plants is popularly supposed to be due to the dry weather.

In the work that has been done to date, several variations in the general aphid life-history have been found. Most noted of these is the absence of sexes in the seasonal history of the aphids. The general statement has been made by Webster (*l. c.*) that south of the 35th parallel the sexual forms of plant lice have been observed but rarely except at high altitudes. Sanderson (*l. c.*) in 1906 reported the occurrence of the development of sexual forms of *M. granaria* in rearing cages at College Station. The next occurrence of sexual forms was recorded by Yingling in 1916 when eggs and oviparous females were taken in the field near College Station. This year, specimens of eggs and oviparous females of *Longistigma caryæ* Harris[1] were taken at Boston in northeastern Texas. Although the sexual forms of the oat aphis, the cornleaf aphis and the green bug occur throughout the north, they have not yet been found in Texas. In the case of the green bug, a very careful search was made, but the other species have not yet been thoroughly investigated. With the melon louse and the turnip louse the sexes have not yet been taken, even in the north.

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[1] Determined by Prof. H. F. Wilson.

Of the species of aphids carefully investigated to date, the normal form of reproduction is asexual throughout the entire year. This has been found to be the case in the green bug, the turnip louse, and the melon louse. Even as far north in the state as Witchita Falls, close to the 34th parallel, viviparous development of aphids persists throughout the winter. Here an inch of snow is not uncommon, which may sometimes remain on the ground for four or five days. Temperatures of 15 to 20° F. are not rare and there may be periods of a week when the temperature is not over 32° F. Under these conditions, the turnip louse and the green bug survive, and reproduction is only retarded. In the extreme southern section of the state where freezing temperatures are uncommon, asexual reproduction proceeds uninterrupted. In January at Brownsville the daily reproduction in the turnip louse was six to eight young, equal to ideal autumn conditions at College Station. At Brownsville, Vickery reared 107 successive generations of the corn-leaf aphis. Only 35 successive generations of the turnip louse were reared at College Station but these occured in twelve months. Sixty-two successive generations of the melon louse have been reared at College Station in twelve months. In all of these cases, no sexual forms have appeared.

In Texas, the summer conditions are more severe for the aphids to withstand, than are the winter conditions. During the very long, hot and dry summers, green succulent vegetation is found in only low, damp and protected places. With the green bug, the migration from grain occurs during June and July, which is the time of the ripening of the grain. During the summer, it was impossible to find any lice in the grain fields, and even if the growing grain was available at this time, it is doubtful if the green bug could survive the temperatures which prevail. It was with much difficulty that the turnip louse was reared throughout the summer on turnips when none were to be found in the field. The melon louse feeds entirely on cotton and okra during the summer months, these hosts being the only ones that are available at that time.

In the turnip louse, with the approach of hot, dry weather, there is a decided reduction in the number produced daily, and all of the stages of life-history are lengthened much the same as under winter conditions. The same condition has been as pronounced in the melon louse in our cage rearing experiments. The month of August seems to be the most severe in the year for the aphids to withstand. During the summer months, general collection of aphids is almost impossible, the spring and fall months being the best for collecting purposes.

In one case, we find a complete reversal of the life-history in the beet louse, *Pemphigus betæ* Doan. The alate viviparous females of

this species may be found on the foliage turnips during October. The apterous females feed on roots of this host throughout the winter, sometimes causing an appreciable loss in truck gardens. The alate forms are found on the foliage again in March and later are taken on cottonwood. On this host, the summer is passed in galls on the leaves. No eggs for this species have yet been observed.

But little attention has yet been given to the economic problems of aphids in Texas, consequently there is a great amount of work to be done in the future. Although extended studies have been made on a few species, the alternate host plants have not been established for a single species. Further work along this line should be fruitful of results.

President R. A. Cooley: I will now call for Mr. Hartzell's paper, "A Method of Graphically Illustrating the Distribution of Injury by an Insect Pest."

A METHOD OF GRAPHICALLY ILLUSTRATING THE DISTRIBUTION OF INJURY BY AN INSECT PEST

By F. Z. Hartzell, *Vineyard Laboratory, New York Agricultural Experiment Station, Fredonia, N. Y.*

In the study of an insect pest, it frequently becomes necessary to investigate the feeding habits of the species together with the movement of the pest in cultivated areas. In such a problem, the labor of the economic entomologist might be divided into two sections: (1) to determine the relations of the insect to the environmental complex; (2) to describe and illustrate these relations accurately and concisely. Various methods can be used to accomplish this result but the writer believes that the simplest and best for the average worker is some form of graphical representation. The use of graphic charts and solid models is common in the study of intricate problems of physics and engineering. If these methods can be adapted to the study of the problems of entomology, the workers in this science will have a vast literature to assist them. The marked superiority of graphical representation over tables or descriptions is sufficient justification for the use of such types of charts.

A common method of illustrating the amount and distribution of insect injury is a map of the infested area in which the varying degrees of injury are represented by shading. This is not sufficiently accurate and does not show the quantitative results we desire. A more accurate method would be to divide the area into small squares and to

indicate the average amount of injury in each square by a number. However, there is apt to result a mass of data which is more or less confusing unless the work is carried farther. If, in addition, we use orthographic projection, representing the amount of injury as an elevation, and interpolate sufficient points having the same elevation, it will be easy to connect these points by means of smooth curves or contours. Each contour is numbered to show its elevation. In other words, we have a topographic map in which the contour lines represent places having equal amounts of injury. The work can be carried to the degree of refinement desired. Unless the detail is too intricate, a slight effort of the imagination will give a good idea of the undulating surface which such contours represent. The weather map is a familiar example of such a chart. The terms isotherm, isobar, and isohyetal lines, as applied to the contour lines in meteorology, are current. Since the chief injury by an insect is generally produced by its feeding, we have designated the line showing equal amounts of injury an *isofag* ('ἴσος, equal+φαγεῖν, to eat). In certain instances, similar lines may be used to show the distribution of equal numbers of insects but here the term *isopleth* ('ισοπληθής, of the same number) might be used, although it should be stated that *isopleth* is used in another sense in mathematics.

Theoretical Considerations

We will assume vast numbers of a migratory species located in a very restricted area in the center of an extensive field having a uniform crop so the pest is at liberty to move with equal ease in any direction. We will further assume that every environmental influence is exerted equally in all directions. Now, as the insects continue to feed it will be necessary for them to migrate and in this movement each insect will fly a short distance. In this general movement usually all food will not be destroyed in the path of the infestation. Since the insects can move in any direction with equal ease—except perhaps toward the center of infestation owing to conditions brought about by their own feeding—it is probable that points equally distant from the center of infestation will sustain an equal amount of feeding. If we map this area and represent the injury by *isofagal lines*, we would find them to be concentric about the original area of infestation. These are shown by the lighter concentric circles in Figure 1. On the other hand, if all these conditions exist except that one influence, as for example, the wind, tends to carry the insects farther in one direction than any other, on mapping such an area, it will be found that the *isofags* would be oval and eccentric about the original area of infestation. These are also shown in Figure 1. Under conditions where the results approach

the uniformity found in this illustration it would be possible to analyze the data and determine mathematically the effect of the disturbing factor. We will omit the mathematical phases in this paper. However, in mapping insect injury, if the center from which the insects spread can be ascertained, the use of concentric circles (or sectors of such circles) about this area if added to the map will indicate the divergence from uniformity.

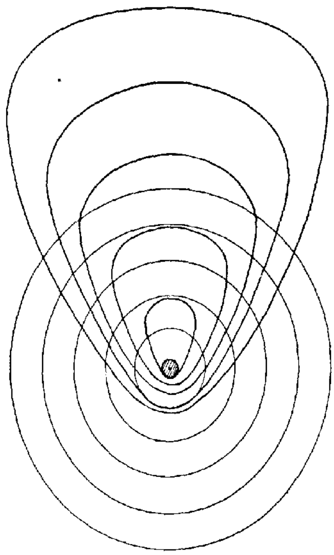

Fig. 1. See text for explanation.

Mapping the Area

In this phase of the problem, we adopt the principles of topographic surveying, the only difference in field work being in vertical control. The first step is to divide the infested area into small subdivisions, preferably squares, and to make a map of the same. The most practical instrument for this use is a small traverse plane table with compass and alidade. In horizontal control, the methods of locating points are those used in plane table surveying, the details of which are given in works on this subject. In surveying, vertical control consists in ascertaining the elevation of primary stations, traverse stations and selected points in the area surveyed, the instruments used being the level or aneroid barometer. Vertical control in mapping insect injury consists in determining the average amount of injury for each subdivision of the infested area and assuming this average to be located at the center of the subdivision. The method of ascertaining the amount of injury will be determined by the nature of the feeding, the degree of precision desired and the speed required. This demands that each investigator must formulate his own methods. The speed required should be determined first. It is essential that the injured area be mapped before any marked changes occur which might tend to obliterate the injury to be determined. Perhaps the most important changes will be produced by the growth or death of the plants infested

and precautions must be taken to maintain the same degree of precision throughout the survey. The results will be more accurate if a moderately precise method be used to determine the amount of injury and the survey be completed before any marked changes occur, than if a more exact method be used but one which reduces the speed to such an extent that decided changes occur before the determinations are completed.

The size of the subdivisions is important. In a vineyard or an orchard, the individual vine or tree may be taken as the unit. These are easily located and can be combined into larger subdivisions if necessary. With field crops, the size of the area should be such as will give a sufficient number of points to determine the isofags to the degree of accuracy required. If undecided as to the size of the subdivisions, it is better to err in making the plots too small rather than too large for, if necessary the small plots can be combined into larger plots, whereas, if made too large, one has no opportunity of correcting the error.

The plotting of the isofags is accomplished in the office by methods of interpolation. In this portion of the work one should use a sufficient number of points to determine the contours so as to show variation in considerable detail but excess of detail should be avoided, as this is apt to make the chart confusing. For the same reason the contour interval should not be too small. We are interested in averages, so too great detail tends to obscure the general trend of the facts and, moreover, requires an amount of labor in plotting that is not justified by the problem.

A Practical Example

On June 4, 1914, our attention was called to a vineyard that was severely injured by the grapevine flea-beetle (*Haltica chalybea*). This insect injures the grape by destroying the swelling buds in the spring. The vineyard was near Sheridan, N. Y., and consisted of about 6.5 acres having 4,097 vines (77 vines missing). It was situated just east of a woodland and northeast of a section of waste land containing approximately fifty acres in which latter were growing great masses of wild grapes, practically all belonging to the species *Vitis bicolor*. The beetles, which hibernate as adults—evidently had greatly multiplied in this area the previous season and during the spring of 1914 invaded this vineyard. Although grapes were cultivated to the southeast, south and west of the waste land, the injured vineyard was somewhat isolated.

On our first visit, it was evident that the injury was not uniform throughout the vineyard and, as it seemed to present a problem that needed further study, we made a map which showed the location and

percentage of injury of each vine in the vineyard. After studying the map we tried various forms of graphic representation but found nothing better than the topographic chart to show the variation in injury in different portions of the planting. We divided the vineyard, as far as

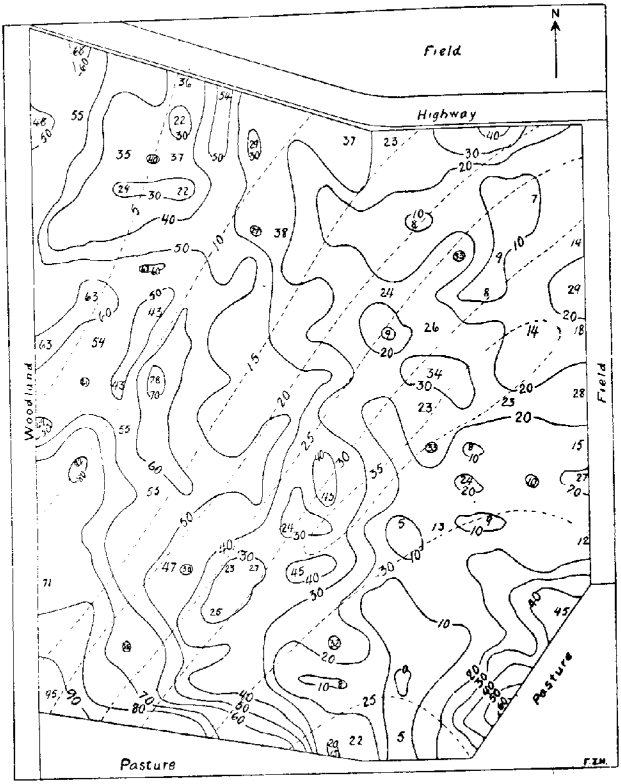

Fig. 2. Isofagal map showing the percentage of injury to grape buds by *Haltica chalybea*. Isofags shown by solid lines. Contours showing elevations in vineyard represented by broken lines.

possible, into squares containing 16 vines each (four vines on a side), calculated the average injury in each square and located this average at its center. With the elevation (percentage of injury) and location of each point on the map, the contour points were found by interpolation and the contour lines drawn. The result is shown in Figure 2.

We have also indicated the elevation of various parts of the vineyard by means of contours with broken lines.

From the map we note the following: (1) the distribution of injury is irregular; (2) the most extensive destruction of buds occurred in the southwestern portion of the vineyard; (3) the west side of the area was more severely injured than the east side; (4) the greatest variation in the percentage of injury was on the south side; (5) taking the vineyard as a whole, the edges show a higher destruction of buds than portions of the area slightly nearer the center; (6) peaks (portions having greater injury than the surrounding areas) and depressions without an outlet (portions having less injury than surrounding areas) are common. In this latter respect, our chart differs from the ordinary topographic map for, on land, depressions without an outlet are generally filled with water and therefore depressions with closed contours are seldom shown.

Regarding the causes of the infestation, we observe the following facts. The center of infestation was in waste land southwest of the vineyard. The beetles fly with the wind and are not active at temperatures below 55° F. and, on the days during May, 1914, when the temperature was above 55° the wind was from the south or southwest. In the vineyard, the movement of the beetles was in the direction of the prevailing wind on the warmer days. The beetles appear to be decidedly adverse to flying in any direction which has an angle of more than 45° to the direction of the prevailing wind. There appears to be no marked correlation between the topography of the vineyard and the distribution of insect injury, although it is to be noted that the infestation was light on the highest portion of the ridge. The woodland west of the vineyard shielded a portion of the area from the cold north and northwest winds, and, as the portion of the area nearest the forest was warmest, we believe the beetles were attracted to this section in greater numbers than elsewhere which accounts for the serious injury on this side of the vineyard. The increased injury near the northern and eastern edges may perhaps be explained by the fact that the vineyard was isolated and also that the beetles fly only from vine to vine. Hence, when they came to the edges of the vineyard, not finding vines beyond, they remained, and others continuing to arrive formed an accumulation of beetles which produced a greater percentage of injury than is found on the vines slightly farther removed from the edges of the vineyard.

A Cardboard Model

In an intricate chart like the one shown in Figure 2, it may be difficult to visualize the relative differences in elevation especially when peaks and closed depressions occur near each other. To overcome

this the writer suggests that a cardboard model be made by using the thickness of the cardboard to represent the contour interval. The outlines of the contours can be secured by placing carbon paper on the cardboard and underneath the map when the lines can be traced. The cardboard can then be cut with a sharp pointed knife and the portion which is lower than the elevation which the contour represents is removed. From these pieces the model can be built and the several parts glued together.

Advantages of Orthographic Projection

The chief advantages of this form of illustration may be summarized as follows:

1. The amount and location of the injury throughout the planting are clearly shown.

2. It permits the worker to use any degree of refinement and precision in the illustration of his problem and the data may be taken with this point in view.

3. When the data are plotted the chart assists in making proper deductions regarding the relationships between the distribution of the injury and the environmental factors.

4. If desired, the worker can use the data for the more exact but more laborious methods of biometrical analysis. Correlation coefficients and equations will give relationships in a quantitative form and can often be used supplementary to an orthographic chart. The point to be emphasized is that data taken accurately for this kind of chart can be used for more detailed analysis but the converse is not necessarily true.

5. This form of chart can be made with comparatively little extra study of principles and methods. In this respect, it surpasses biometrical analysis for the average worker, since the latter type of analysis requires a rather extensive ground work in mathematics, including calculus, theory of probability and least squares, before one can use the methods with facility and precision. It is true that one must master the principles of topographic surveying but these are not very difficult. The acquiring of speed and accuracy in field work will, however, require practice. To the worker who is not acquainted with the principles of topographic surveying, we would suggest that he first make a map of an area, in which the surface is sufficiently undulating to require considerable plotting to locate the contours. This preliminary exercise will assit him in plotting isofags where the positions of the contour points are not as obvious as in topographic surveying.

6. The chart, if not too intricate, is readily comprehended. Even an intricate chart presents the conditions throughout every portion of

the planting better than tables or any other form of graphical or pictorial representation known to the writer.

7. A solid model of the conditions represented in the chart may be made either for the purpose of teaching the principles involved or when the amount of detail tends to become confusing.

PRESIDENT R. A. COOLEY: If there is no discussion, I will ask Mr. A. W. Morrill, Second Vice-President of the Association, to take the chair during the next number on the program, which is the discussion of the presidential address.

VICE-PRESIDENT A. W. MORRILL: The next number on the program, as announced, is the discussion of the presidential address. I should be glad to hear from any one present.

MR. H. A. GOSSARD: Mr. Chairman, I am quite sure that as a member of the Association I am indebted to the President for that very careful outline of the present situation. Doubtless every entomologist in the country has asked how he can best serve the country. We all ought to serve the country, and each one of us feels responsibility resting upon him in that service.

I am impressed with the remark that research is far ahead of knowledge. There is a vast mass of entomological information of which the farmer does not avail himself, and it is hardly available to him under our present organization.

The war is going to be very useful to us in developing an organization to carry this information to the people who need it most and for whom it was originally discovered. I find that our people are demanding entomological information. At the Ohio experiment station we have an editor of publications who keeps a tabulated record of the various papers, periodicals, etc., and makes use of our press bulletins and matter printed for general publication. We find that the press bulletins furnished by the Department of Entomology are more largely printed than those furnished by any other department. Our bulletins last summer were printed in seventy-seven different newspapers, were made use of by at least two press bureaus and other departmental stations had an equal record. We interpreted that as an indication that the public wanted information in regard to the saving of crops that they had already planted and brought to the point where they seemed to be ready to yield harvest and yet were frequently being snatched away at just the time when the farmer thought he had dollars in his pocket and food in the bin.

I am satisfied that we can work out extension programs that will be in demand and will be appreciated by our people.

I also appreciated very much the general discussion regarding coördinating the work over the country. We feel the need of that in our state and are getting matters adjusted just as fast as we can, but a great nation-wide coördinating bureau will mark a great advance in practical entomology, the kind that the farmer wants and the kind that he pays taxes for, and that he thought he was going to get when the experiment stations and the bureaus of entomology were established.

Mr. W. C. O'Kane: We are fortunate in having set before us at this time the keen and the valuable analysis that President Cooley has given in his address. I think it is never harmful to make changes, when those changes represent progress, and it doesn't make any difference what condition or circumstances gives rise to the changes; whether it be war or something else.

We have had brought home to all of us certain things that we can do, because the war has emphasized those things. President Cooley has analyzed the situation and has pointed the way. It is inevitable that practice should fall a little behind research, but it is our ambition to balance them so far as our human abilities will let us, and we know that we have a long way to travel in many of the problems.

A war brings many difficulties, but it brings privileges, and the entomologist who will rise to the opportunity presented by the present world situation will only be rising to a privilege.

Mr. S. J. Hunter: The President's address in a very timely and fitting way has presented to us the advantages at this time of coördination first, coöperation next, and personal contact last of all. Through the management and organization set forth there, we can get results which are comparable in the degree to which they are carried out. We have organization in other lines at the present time in this crisis. Why should we not have it in entomology?

The extent to which the President has outlined the degree to which this should be carried between the state and federal and the local authorities is along the lines of the highest efficiency, and I believe we will go away from here, each one of us in the work that is assigned in each one of our states, with a clear idea of the possibilities of carrying out to the fullest degree this line of organization.

Mr. S. A. Forbes: I was particularly interested and pleased with the President's address this morning because it makes quite unnecessary the little contribution which I had in mind to make in the discussion tomorrow forenoon: the fact that President Cooley said virtually everything I had in mind.

There is one thing, however, that I may add. We all appreciate the great privilege and opportunity which has come to us out of the desperate conditions growing out of the war; in the fact that we not

only are put upon our mettle to do the things that are required of us, but that we have the backing and assistance in every state in our country to help us do the things they want us to do. For example, in the state of Illinois the managers of the Associated Press and of the United Press Association came to me with requests for articles, just as many as I choose to put out, on any subject that I thought was pertinent and important, and they agreed to put those articles verbatim into every paper on their lists. The State Council for Defense makes the same proposition, and they have access to every paper published in the state, and so at every point if there is any agency that we can make use of, they are ready and willing to help us out. We have a chance to accomplish work and get standing with our communities and help the public and bring the matter to a practical phase of application, which we have never had before and the like of which we all hope we may never have again.

We have one feature of the situation in Illinois which I think you have reason to envy in view of the emergency which is upon us. At the session of the legislature last winter there was a law passed which gives the Director of Agriculture, known as the Commissioner of Agriculture in most states, the power to issue a proclamation, whenever an insect pest threatens serious injury either by multiplication or by spreading to territories not previously infested by it, and to make requirements upon the people by this proclamation to prescribe what they shall do and if they fail to carry out the requirements of the Director of Agriculture as thus publicly announced, they are subject to prosecution—they are guilty of a misdemeanor. We have the whole force of law behind any requirement which an emergency like this may call for. For example, in Illinois, the chinch-bug became quite a serious menace last spring. If, when the season opens next spring, it seems that that is a real serious emergency condition, we shall call upon the Director of Agriculture to issue a proclamation requiring those whose properties have been infested, to take certain precautions, and failing to do so they will be violating the law and subject to penalty. I think this is a step which most of the states have not yet taken.

VICE-PRESIDENT A. W. MORRILL: Are there any further remarks? Before turning over the chair, I want to say that I think we are all agreed that the President could not have selected any more appropriate subject and that we all appreciate the very fine way in which he has handled the subject.

PRESIDENT R. A. COOLEY: The next paper is entitled "The Life-History of the Strawberry Leaf-Roller," by Mr. Webster.

NOTES ON THE STRAWBERRY LEAF-ROLLER

(*Ancylis comptana* Fröhl.)

By R. L. Webster

This common insect has been most reported from states of the Mississippi Valley. Elsewhere in this country it has caused little notice. In the course of some work with this species in Iowa much new data were secured. A more complete account is to be published in a forthcoming bulletin from the Iowa Agricultural Experiment Station.

Most of the notes were taken at Ames in the last four years. W. O. Ellis and J. L. Horsfall have assisted the writer greatly in taking records and in making observations. These notes are from the files of the Entomology section, Iowa Agricultural Experiment Station at Ames.

Hibernation

Many contradictory statements have been made as to the manner in which this leaf-roller hibernates. For instance Riley (1869) stated that the insect hibernated as the pupa. Forbes (1884) said that the moths hibernated, appearing on the wing early in spring. Stedman (1901) makes the definite statement that the insects winter as larvæ in Missouri. Again M. H. Swenk (1908) says that the winter is spent as pupæ and J. B. Smith (1909) indicates that in New Jersey the winter is spent as pupæ. C. A. Hart (1911) states that it was determined that the larvæ hibernate in central Illinois.

The insect has been closely observed at Ames for several years, both in late fall and in early spring. Late in the fall (October), only larvæ were found. Again in early spring (March) only larvæ were present, pupæ not appearing until mid April. For central Iowa, at any rate, it is evident that the winter is spent as larvæ.

The Generations

Riley (1869) stated that two generations occurred in Missouri but Stedman (1901) indicated three. Garman (1890) showed that three generations occurred in Kentucky. Most writers have followed the old statement of Riley. M. H. Swenk (1908) gives three broods for Nebraska and C. A. Hart (1911) four in central Illinois.

The overwintering larvæ, which are nearly full grown, feed to some extent very early in spring but soon mature and transform to pupæ and later (in April) to adults. The moths deposit eggs and the leaf-rollers appear in late May and during June. This first brood frequently becomes very abundant and often causes severe damage to

strawberry foliage. A second generation appears late in June, and this is likely to last well through the month of July.

Again in August a third generation appears. This may be followed, in some years, by still another generation in September, making four generations. Our observations indicate that the fourth generation is not always complete and that, in some years at least, third generation larvæ spend the winter in strawberry foliage.

The most important facts from the study of the life-history are those bearing on the practical treatment. To be effective, spraying must be done early in the game, that is, before the larvæ have folded or rolled the leaves. After the leaf-rollers begin feeding and rolling leaves any treatment by spraying is largely ineffective.

The first chance for effective spraying is early in May. Arsenical spraying for strawberries, however, should be made previous to blossoming, since spraying while plants are in blossom would probably poison bees. Spraying at this time, that is, about the time the eggs are deposited, is essential to place the poison on foliage before the eggs hatch.

The Egg: Description

J. M. Stedman (1901) seems to have been the first one to observe the eggs and these were described by him, although no measurements were given. J. B. Smith (1909) also described the eggs and C. A. Hart (1911), working over notes made by J. J. Davis and the writer in Illinois in 1905 and 1906, gave a description and measurements.

The egg: Oval, varying greatly, much flattened: pale yellow-green, translucent. Surface pitted with numerous slight hexagonal depressions. Length .68 mm. Width .48 mm. (Average of 10 specimens deposited on foliage.)

Eggs deposited on the glass in insectary cages were quite uniform in shape; a true oval. The surface of the strawberry leaf with its fine hairs influences the shape of the egg on a leaf.

Place of Deposition

Stedman, Hart and J. B. Smith all state that the eggs are deposited on the under sides of the leaves. J. B. Smith stated that he had never seen an egg on the upper surface.

In field observations eggs were found placed on either surface and even on the stems. In the insectary cages, eggs were usually deposited on the upper leaf surface but frequently were placed on the inner surface of the glass chimney in which moths were confined. Field observations, in which counts were not made, indicate that on the whole the lower surface was preferred. The highest number of eggs found on a single strawberry leaf in the field was five.

Length of the Egg Stage

The length of the egg stage in spring and in summer varied. In the insectary in May, 1914, eggs hatched in 11.1 days, an average from 104 eggs, according to notes by the writer. In July and August, 1914, much less time was required; 115 eggs hatched in 5.5 days (average). The range was from 3 to 8 days.

In July and August, 1915, more time was required and an average of 8.5 days resulted in computing the data from 108 eggs. August, 1915 was the coolest August on record and July, 1915, with one exception, the coolest, so that the effect of temperature is clearly evident here. The range in 1915 was from 3 to 12 days.

On the contrary July, 1914 was, with one exception, the warmest July on record. Two extremes of temperature then have affected these records of the length of the egg stage.

Only one accurate record is available for July, 1916, when 21 eggs hatched in 5 days.

Number of Eggs Deposited by One Female

No one has previously given any records of the number of eggs deposited by a single female, so far as the writer is aware. Single pairs of moths were placed under large glass lantern globes which enclosed growing strawberry plants and daily records were made of all eggs deposited in the cages.

The records of 35 female moths indicate an average of 72.9 eggs per female. This average is undoubtedly low, because some moths died soon after being placed in the cage and consequently did not deposit a normal number of eggs.

The highest number of eggs deposited by one female was 136, according to a record by J. L. Horsfall in August, 1916. The lowest number was 12. In this last case the moth died the seventh day after being placed in the cage.

The Larval Stages

Newly hatched larvæ are about 1.5 mm. long. Four larval stages were determined by W. O. Ellis in the insectary in 1914. Single newly hatched larvæ were isolated in glass vials, fed on strawberry foliage, and the growth carefully observed from day to day.

Measurements of the head widths were made after each moult and recorded. From all the data accessible head width measurements of the four stages averaged as follows: Stage I, .22 mm.; Stage II, .33 mm.; Stage III, .59 mm.; Stage IV, .85 mm.

In 16 cases accurate records of the length of the entire larval stage, egg to the pupa, were secured. These averaged 19.8 days, from larvæ reared in July and August.

Variation in Color of Larvæ

Riley (1869) mentions a variation in color of larvæ from light yellowish brown to dark olive green or brown. Other writers have also mentioned this variation. This color appears to be seasonal in its occurrence, according to our observations in Iowa. During the greater part of the season the normal color is a yellow-brown. In September and October, as the cooler weather comes on, the larvæ assume a dull olivaceous color. In the fall both light and dark colored larvæ have been found at the same time. In spring the overwintering larvæ are dark in color, but the first generation from eggs are light.

Length of Pupa Stage

The pupa stage in summer is much shorter than in spring. From meagre data the length of this stage in April and May was found to be from 14 to 18 days. In the summer months an average of 6.4 days was spent as pupæ. This average is from 96 individual records in the years of 1914, 1915 and 1916.

Much difference in the time required was found in different years. Much longer time was required during the exceptionally cool summer of 1915, than in 1914 or 1916, when it was very hot. The length of the pupal stage was essentially the same for both sexes.

Length of Life of the Moths

Some data on the length of life of adult moths were secured in insectary cages, where individual pairs were confined for egg records. As a rule a little water sweetened with sugar was placed in these cages for food. In 1916 honey was substituted for sugar.

Twenty-four female moths lived on an average of 10.2 days, with a range of from 3 to 28 days. Nineteen male moths lived on an average of 10.1 days, with a range of from 3 to 23 days. It was thought that the males died more quickly in the cages than the females, but the average is too slight to consider of any importance.

In compiling these data only accurate records were used. In some cases moths were noted in the insectary experiments as having escaped. None of these records are used here, since the time of death of the insect was uncertain.

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PRESIDENT R. A. COOLEY: Do you wish to offer discussion on Mr. Webster's paper? If not, we will pass to a paper by Mr. Peterson, "Some Experiments on the Adult and Eggs of the Peach Borer."

SOME EXPERIMENTS ON THE ADULTS AND EGGS OF THE PEACH TREE BORER, SANNINOIDEA EXITIOSA SAY, AND OTHER NOTES

By ALVAH PETERSON, PH.D., *Assistant Entomologist, New Jersey Agricultural Experiment Station*

During the summer of 1917 a study was made of the peach tree borer at Mr. James M. Moon and Son's peach orchard near Clementon, N. J. This orchard has about eighty acres of seven- to eight-year-old peach trees of different varieties and for several years has been heavily infested with borers. The larger part of the orchard is on a light white sand soil and the smaller portion on a heavier gravel sand soil.

The majority of experiments were conducted under two large wire-screen cages located in the white sand portion of the orchard where the infestation was most severe. One all wire screen cage (12′ x 12′ x 9′) was constructed about a peach tree while a second wire-screen cage (8′ x 8′ x 6′) with a wooden roof covered with rubberoid was placed in an open space besides the large cage. These cages were built and put into position by Mr. J. B. Moon and Mr. Robert Schellenger and we are greatly indebted to them for their coöperation and the interest shown in this investigation. I am also indebted to Dr. T. J. Headlee for many valuable suggestions and the sincere interest shown.

The problem of the peach borer was approached from several aspects, but the principal lines of investigation were the food and feeding habits of the adults, the response of the female when ovipositing to various materials commonly used in spraying and other chemicals, the susceptibility of the eggs to certain contact insecticides and other compounds, and the effectiveness of certain mechanical protectors (Scott's tree protectors) and various chemicals (principally spray mixtures) in keeping the larvæ out of the tree. The last mentioned phase of the peach borer problem cannot be reported on at this time for it will be necessary to wait until the spring boring (1918) has been completed in order to obtain the desired data.

During the past season the adults emerged in the greatest number about the middle of August; a few were seen throughout the month of July and the last to emerge came out about September 15. Emergence occurred during the early hours of the morning (never after

9 a. m.) and copulation took place within one to twenty-four hours after coming out. No difficulty was experienced in getting captive males and females to copulate in captivity. This took place in the morning hours and usually ran from forty-five minutes to one and one-half hours. When through copulating, the female would start to deposit eggs in five to thirty minutes and continue this performance in the day time (9 a. m. to 4 p. m.) for forty-eight hours or even longer in some cases. The number of eggs deposited and possessed by different females varied considerably as seen in Table I.

TABLE I—NUMBER OF EGGS DEPOSITED AND THOSE IN ABDOMEN OF TEN FEMALES USED IN EXPERIMENTS

♀	Deposited	Abdomen	Total	♀	Deposited	Abdomen	Total
(1)	452,—74%	154,—26%	606	(6)	323,—75%	104,—25%	427
(2)	75,—39%	117,—61%	192	(7)	305, 66%	154,—34%	459
(3)	313,—70%	132,—30%	445	(8)	218,—34%	420,—66%	638
(4)	511,—73%	187,—27%	698	(9)	234,—63%	133,—37%	367
(5)	372,—69%	165,—31%	537	(10)	342,—69%	153, 31%	495

Average deposited was 314 or 64%, average remaining in abdomen was 170 or 36%, and average total was 484 Smallest number deposited was 75 and largest 511. Smallest female possessed 192 eggs and largest 698.

Many new and interesting facts have been observed in respect to the behavior of the adults but these will be omitted in this paper.

FOOD AND FEEDING HABITS

In respect to the food and feeding habits of the adult stage, it can be said that in all experiments and observations made under cages or throughout the orchard and in nearby woods no adult was ever seen to partake of or show any desire for food or liquid during its entire adult existence. Males and females would emerge from pupæ, copulate and then the female would proceed to deposit at least two-thirds the total number of eggs within her body and in the meantime show no desire for food. Anatomically the mouth-parts of the adult and their connection with the œsophagus seems to be normal and compares favorably with similar structures in adults of other species of the Lepidoptera that are known to feed.

The following chemicals were used in liquid form at varying dilutions in a number of experiments to tempt the adults to feed: corn syrup ("Karo," diluted one-half), cane sugar, honey, maltose, lactose, fructose, dextrine, acetic acid, ammonium hydroxide, pyridine, alcohol, formic acid, clove oil and distilled water. Fresh and decayed peaches and fresh peach gum were also used, but without success.

From the above results one can readily see the improbability of developing an attractive poison bait for the adult.

Repellents

When the female wishes to deposit her eggs she feels about the surface of the object on which she is located with the tip end of her abdomen. With this observation in mind it was thought that certain chemicals might repel her or at least keep her from depositing eggs on sprayed surfaces such as sprayed peach branches. Table II gives the results of a number of experiments with various spray mixtures. In each experiment one fertilized female was placed in a small round wire-screen cage (6 inches in diameter and 9 inches high) and two peach branches in an upright position (1 inch in diameter and 8 inches long), one sprayed and the other serving as a check. Light did not influence the female in depositing eggs for the position of the branches was reversed nearly every hour.

Table II—Repellent Effect of Sprays during Oviposition

Expt.	Spray	Check Branch	Sprayed Branch	Cage	Floor	Total
1	"Scalecide," 1-15	129	16	3	45	192
2	"Scalecide," 1-15	37	53	141	82	313
3	"Scalecide," 1-15	76	84	40	105	305
4	"Scalecide," 1-15 / Carbolic, 1-99	211	42	44	24	321
5	Lime-sulphur, 1-9	163	86	196	7	452
6	Lime-sulphur, 1-9	80	6	130	96	372
7	Lime-sulphur, 1-9	25	8	0	0	33
8	Lime-sulphur, 1-9	103	53	72	6	234
9	Nicotine resinate, 1-100	93	66	20	0	179
10	Fish oil soap, 1-16	313	27	118	53	511
11	Fish oil soap, 1-16	133	15	48	127	323
12	Fish oil soap, 1-32	154	30	14	20	218
*13	Fish oil soap, 1-100 / Carbolic acid, 1-99	20	18	0	11	49
14	Fish oil soap, 1-100 / Carbolic acid, 1-99	24	31	17	3	75
15	"Fly-skat," 1-10	212	16	41	3	272
16	"Fly-skat," 1-10	160	25	174	133	492
17	"Fly-skat," 1-10	64	75	72	28	239
†18	"Fly-skat," 1-10	7	13	3	29	52

* Fly-skat is chiefly a creosote compound.
† Fertility of female questioned.

The results of the experiments recorded in Table II are not as definite as might be wished for; however, they do show the partial repellent effect of certain mixtures on the female during oviposition (Experiments 1, 4, 5, 10, and 15).

On August 21, one large experiment was set up in the large cage (8′ x 8′ x 6′) to determine the response of the female to various spray mixtures and this experiment ran continuously until September 21. Thirty-two peach branches, one to two inches in diameter and eighteen inches long, were cut on August 21 and sprayed; six with "Scalecide" (a miscible oil), 1-15 (Sc), four with "Fly Skat" (a creosote compound), 1-10 (Sk), six with lime-sulphur, 1-9 (LS), six with fish oil soap, 1 gr.-32 cc. (F), and ten checks (Ch) or unsprayed branches.

These branches were placed under a wooden frame (36″ x 18″ x 18″) covered with white mosquito netting and were arranged according to the following diagram. The branches on the outside rows and those at the ends stood upright while those on the inner row were tilted (45° angle) toward the middle and the opposite branches tied together at their tip ends. The letters in the diagram indicate the material used in treating and the number adjacent to the letters indicates the numbers of eggs on the respective branches. Ten tin cans (T.C.) were filled with moist sand and each possessed from 8–12 living pupæ in cases. These were placed in the center. This experiment ran for thirty days and in this period some sixty adults emerged and over 6,000 eggs were deposited by the females. The distribution of the eggs can be seen in the diagram and the average per branch in the table accompany the diagram.

Diagram Showing Arrangement of Sprayed and Unsprayed Branches and the Number of Eggs Deposited on the Respective Branches. The Top Margin of the Experiment Faced the North

Ch 525	76 Sk	F 203	101 Ch	LS 234	118 Sc	Ch 342	51 Sc	LS 182	91 Ch	F 245	31 Sk	Ch 540
Sc/266												180/Sc
		T.O.		T.C.		T.C.		T.C.		T.C.		
LS/175												170/LS
		T.C.		T.C.		T.C.		T.C.		T.C.		
Sc/235												111/Sc
685 Ch	Sk 22	108 F	Ch 164	72 LS	F 83	176 Ch	F 176	95 LS	Ch 118	126 F	Sk 36	261 Ch

Average Number of Eggs per Branch Receiving Similar Treatment

Spray	Average Number of Eggs on Branches		
	Upright	Tilted	Total Av.
Ch,—Check branches	421	116	300
F, -Fish oil soap	170	129	156
LS, -Lime sulphur	154	...	154
Sc, -"Scalecide"	195	84	158
Sk,—"Fly-skat" (Creosote)	...	41	41

The above experiment and the experiments with individual females (Table II) show the partial repellent effect of certain materials on the female when ovipositing. In a number of cases the repellent served to cut down the number of eggs 50 per cent and in some instances the reduction was below this, but no material completely repelled the female. How females would respond to these mixtures in the orchard has not been determined, but so far as we know they would behave in a similar manner. Since the above sprays will not repel the female in captivity, it is inadvisable to make use of these materials in the orchard with the purpose of repelling the female.

One interesting point in the above experiments is the location of the eggs of the peach borer. The female usually deposits eggs on peach trees only, but in the above experiments the eggs were deposited to some extent on the cage and floor of the cage. This indicates that the female does not always deposit eggs on peach trees which agrees with observations made by various investigators.

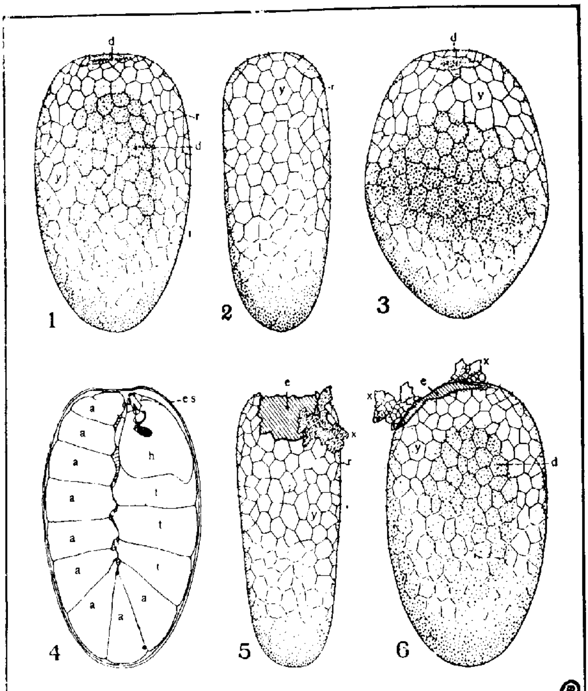

Fig. 3. See text for explanation.

Eggs

The egg of the peach borer is a small flattened ellipsoidal body with one end broader (more obtuse) than the other (Fig. 3, 1 and 2). The egg averages .65 mm. (1/40 of an inch) in length and .4 mm. (1/60 of an inch) at its greatest width. The two broad surfaces of the egg are flattened and slightly concave (d) and one of these surfaces is adjacent to the object on which the egg is deposited. The egg has a soft chest-

nut brown color and possesses distinct hexagonal and variously shaped areas (y) on the surface. These areas are marked off by elevated light colored lines (r) and are most prominent toward the large end of the egg.

A distinct larva (Fig. 3, 4) may be found in a U-shape position within the egg two or three days before hatching; the head and caudal portions located near the large end of the egg. When the larva is ready to emerge it breaks through the thin depressed area (d) at the large end of the egg. It punctures the shell with its mandibles and then continues to tear down the egg shell (e. s.) ventrad of the head until the opening (e) is large enough for it to crawl out (Fig. 3, 5 and 6). The bits or fragments (x) of the egg shell torn off by the mandibles of the larva are not consumed, but shoved to one side.

The eggs of the peach borer require from 9 to 11 days to hatch, but in a few cases it took a day or two longer. From 90 to 100 per cent of the fertilized eggs hatched in the checks used in the various experiments while eggs deposited by unfertilized females never hatched. When eggs were deposited on sprayed branches, the spray never affected their hatching.

A few experiments were conducted with the eggs. They were sprayed with various chemicals, principally common contact insecticides and the effect of these on the eggs is shown in Table III. Eggs which did not hatch usually collapsed as in Figure 3, 3 this was particularly true of eggs killed by "Scalecide" (a miscible oil) and "Fly-skat" (a creosote compound). All eggs were sprayed within five days after they were deposited.

In the following experiments no material was sufficiently effective to consistently kill 100 per cent of the eggs or enough to make any one material worthy of being considered an infallible agent in killing peach borer eggs. "Scalecide," a miscible oil, at varying strengths gave the best results, killing 40 per cent to 100 per cent of the eggs in the different trials (Experiments 1–6) and the stronger concentrations were the most effective. "Scalecide" combined with crude carbolic (Experiments 5 and 6) was given two trials. "Fly-skat," 1–10 (largely a creosote compound) was given several trials and the results vary somewhat. In Experiment 8 (no check) two eggs failed to hatch out of 47 while in Experiments 7 and 9 about 66 per cent of the eggs were killed. A few experiments were conducted with fish oil soap alone, fish oil soap and crude carbolic, and laundry soap and cresol, but these are not extensive enough to base any conclusions on them. Lime-sulphur, 1–9, was tried (Experiments 13 and 14) and 30 per cent were killed in experiment 13. Nicotine resinate was given a number of trials (Experiments 15 to 19) at varying strengths (1–100, 1–250,

TABLE III—TABLE SHOWING EFFECT OF SPRAYS ON EGGS

Expt.	Spray	Total Eggs	Eggs Hatched	Eggs Dead
1	"Scalecide," 1-15	44	0	44
1	Check	29	27	2
2	"Scalecide," 1-10	104	24	80
2	Check	29	27	2
3	"Scalecide," 1-20	102	28	74
3	Check	15	13	2
4	"Scalecide," 1-30	103	43	60
4	Check	11	11	0
5	"Scalecide," 1-15 plus Carbolic, 1-99	41	0	41
5	Check	29	27	2
6	"Scalecide," 1-20 plus Crude carbolic, 1-99	40	7	33
6	Check	93	93	0
7	"Fly-skat," 1-10	45	15	30
7	Check	44	44	0
8	"Fly-skat," 1-10	47	45	2
9	"Fly-skat," 1-9	57	19	38
9	Check	16	15	1
10	Laundry soap, 1-200	60	54	6
10	Check	31	28	3
11	Fish oil soap, 1-10	57	2	55
11	Check	34	34	0
12	Fish oil soap, 1-10 Crude carbolic, 2-99	61	0	61
12	Check	33	33	0
13	Lime-sulphur, 1-9	36	23	13
13	Check	29	27	2
14	Lime-sulphur, 1-9	42	32	10
14	Check	53	44	9
15	Nicotine resinate, 1-100	41	40	1
15	Check	29	27	2
16	Nicotine resinate, 1-100	64	61	3
16	Check	28	24	4
17	Nicotine resinate, 1-100	30	29	1
17	Check	31	28	3
18	Nicotine resinate, 1-250	102	100	2
18	Check	11	11	0
19	Nicotine resinate, 1-500	82	82	0
19	Check	59	57	2

and 1–500), yet in no experiment was there a sufficient number of eggs killed to warrant the statement that this material might kill eggs. It was thought, when the material was used, that it might act as a stomach poison and kill the larva as it ate (apparently) its way out of the shell, but as pointed out before the larva probably does not consume any considerable portion of the shell as it breaks through with its mandibles. Nicotine resinate has good lasting qualities and is not readily decomposed after spraying, consequently, any larva which consumes its shell would suffer if nicotine resinate were present.

The lasting effect of nicotine resinate is shown in one experiment where on July 16 the lower portions of fifteen seven-year-old peach trees were sprayed with two and one-half gallons of nicotine resinate, 1–100 (one gallon for six trees). Small pieces of bark were removed on July 23, July 30, August 4, August 13 and August 21 from the trees which only received one treatment, and placed in a clean test tube with a small amount of distilled water and shaken. After standing for about 30 minutes the solution was filtered and a few drops of silicotungstic acid solution were added to the clear filtrate. Immediately the solution became cloudy having the appearance of a white milky solution. Bits of bark removed from unsprayed check trees were also tested each time and in all cases the filtrate remained clear. The sprayed trees were tested again on September 21, but at this time there was no indication of nicotine. The above qualitative test for nicotine is recommended by Mr. V. I. Safro. (See, "How to Test for the Presence of Nicotine on Sprayed Plants," JOURN. of ECON. ENT., 1917, vol. 10, pp. 459–461.) The above experiment shows a definite test for nicotine on the bark of peach trees five weeks after application of nicotine resinate, 1–100. It should also be noted that a number of heavy rains occurred between July 16 and August 21.

SUMMARY

The results in the above experiments are largely negative, so far as they may help to develop a much needed control measure for the peach tree borer. In brief they show the improbability of developing a poison bait for the adult, the partial repellent effect of certain chemicals on the female while ovipositing and the partial destruction of eggs when certain substances are applied as a spray. A number of experiments have been started and are now in operation on the use of various chemical and mechanical tree protectors but the evidence obtained thus far is insufficient to warrant a statement at this time. The author is of the opinion that the peach borer problem will be solved when some mechanical or chemical barrier is found which will kill the larva before it enters the tree or prevent it from getting into the tree. The development of any control measure along the line of killing the larva after it enters the tree is not advisable.

PRESIDENT R. A. COOLEY: Mr. Peterson's interesting paper is before you for discussion.

SECRETARY A. F. BURGESS: I notice on the program that in Mr. Peterson's summary he made note of the use of tree protectors. I wonder if he has any information on that subject that he didn't give in his paper.

MR. ALVAH PETERSON: In the last statement made on the use of various chemicals and mechanical barriers against the young borers, it was said that up to date we haven't sufficient data to give any conclusive facts in regard to the use of tree protectors. We put on one hundred Scott tree protectors and also sprayed a number of trees with various chemicals and insecticides such as fish oil soap, nicotine resinate, "scalecide," crude phenol, etc. During the past season, the adults came out late compared with records of former years. In New Jersey, the greatest emergence occurred about the 20th of August. This late emergence gave the majority of the larvæ only a short time in which to grow before winter set in, consequently we found that the larvæ were very small when we bored the trees about the 15th of November. In boring we found no small larvæ under the tree protectors, but I am not sure that this will be the condition when we bore again next spring. In using tree protectors, we not only sealed them with asphalt and some with borene, but we also made use of a strong paper clip which was slipped over the tarred paper where the two margins overlapped. This helped to hold the protector in position while the asphalt or borene sealed the openings. Where paper clips were used, it was only necessary to reseal the protectors once about 30 days after they were put on and at this time only 50 per cent of them showed any cracking or splitting. The above does not agree with our former experience with tree protectors where we resealed several times. Undoubtedly the paper clip is an important additional feature.

Since we are still experimenting with tree protectors, I am not willing to go on record as saying that the tree protector is going to eradicate the larvæ, but so far as the present evidence is concerned it looks favorable.

MR. J. L. KING: Mr. Peterson's remarks concerning the tree protector as a control of peach tree borers are very interesting to me. His results are more encouraging than my first experiments were. While an assistant in the Ohio Experiment Station in 1916 we conducted a test of 70 tree protectors at Gypsum, Ohio.

The first orchard used was about seven years old, and was seriously infested with Sanninoidea larvæ, which averaged 7 per tree, with an 100 per cent infestation in the check trees. In this orchard 50 protectors were placed about June 15. One-half of these were sealed with tar and the remainder with tree tanglefoot. The protectors were resealed three times during the egg-laying season (July 5 to September 5). At the close of the season the trees were examined for borers. The infestation was 100 per cent, and the average number of larvæ per tree was 5.

In the second orchard a plot of 20 trees was used. These were 7

years old. Twenty tree protectors were placed about the trees in mid June, and resealed, as in the first plot. At the close of the season they were examined for borers. The per cent of infestation was 30, as compared to 40 per cent in the check plot. In this second plot a number of large ant nests were found under the protectors, which served as ideal places under which to build their nests.

Perhaps the failure of the tree protectors in this case may be explained by the fact that the high winds sweeping over Lake Erie and Sandusky Bay sway the trees to such an extent that it is very difficult to keep the protectors tightly sealed for any length of time.

President R. A. Cooley: Is there any further discussion on this paper? If not, I will call for the next paper, "The Apple Ermine Moth in New York," by Mr. Parrott, of Geneva, N. Y.

This paper will be presented by Mr. Fulton.

THE APPLE ERMINE MOTH

By P. J. Parrott, *New York Agricultural Experiment Station*

In the Journal of Economic Entomology, vol. 3, p. 157, a brief account was given of the occurrence of the cherry ermine moth (*Yponomeuta padellus* L.) on imported cherry seedlings. Since the publication of this article an associated species has been observed on apple, and it is desired at this time to place on record some notes relative to its identity and distribution in nurseries and orchards.

Of the various species of insects imported from Europe on apple seedlings no other is more persistent or occurs in such large numbers as the ermine moth. Since our attention was attracted to it in 1910, no year has passed that the horticultural inspectors have not discovered colonies of caterpillars in plantings of foreign stocks. Moreover, recent years have witnessed greatly increased numbers of the insects. During 1915 and 1916 approximately 4,223 infested plants were discovered, while during 1917 all previous records were exceeded as 13,674 seedlings infested with caterpillars were discovered and destroyed. In view of the experiences in New York it is a significant fact that neither this species nor the associated form have so far been reported from any other state. The only area on the American continent outside of the state of New York from which the insect has been reported is New Brunswick where, according to Dr. Hewitt, it was found necessary to destroy 450 imported apple seedlings because of the presence of egg masses.

Aside from the increased abundance of the insects in foreign importations, we have also to record the discovery of the pest in three bear-

ing orchards in the region of Seneca Castle, by Messrs. Maney and Rupert, Horticultural Inspectors of the State Department of Agriculture. The orchards were in the immediate vicinity of nursery plantations, and the infestation of the trees unquestionably occurred during 1916, when moths originating from eggs on imported apple seedlings sought neighboring orchards for purposes of oviposition. Notwithstanding the presence of other kinds of fruit, the infestation was entirely confined to apple trees.

The occurrence of the insect on apple and not on cherry raises the question to which species it belongs,—to *padellus* or *malinellus?* As we have previously pointed out, the moths of the former species are exceedingly variable in their markings, and unfortunately the identification of the two species seems to rest largely upon color distinction of the adult insects. In spite of seeming morphological and biologic differences, the separation of these insects is difficult and unsatisfactory; and there exists consequently considerable uncertainty as to the actual status of these two forms. The adults of *padellus* reared from cherry and hawthorn particularly, and of *malinellus* from apple represent for the most part extremes in wing coloration. The former contains a majority of moths which have the primaries and fringes clouded, greyish or lead colored, while the latter has a majority of moths with primaries and fringes white. The two are distinct enough when characteristic examples are selected, but the separation of them becomes difficult when the intergrading forms are considered, as they merge into each other by imperceptible gradations.

In order that the moths recently bred from apples should be correctly identified, specimens were forwarded to Dr. Paul Marchal, Paris, who has devoted considerable attention to these insects, and in a letter dated October 20, 1917, he reports as follows: "The *Hyponomeutas* which you forwarded to me have arrived. They were in rather bad condition as the wings of two specimens were detached; however they agree well with the species *H. malinellus*. They are distinguishable from *padellus* by the front wings, the ground color of which is white, while the margins, examined from below, are finely bordered with white. The fringe of the anterior wings is also mostly white, and not grey as with *padellus*. Although the moths are considered distinct species I am not at all certain but that under certain conditions one form may produce the other. It cannot be positively denied that they are not two varieties of the same species."

Breeding experiments are needed to definitely settle the status of the two moths, but until these are undertaken the example of European writers may well be followed of designating the insects bred on hawthorn and cherry as *padellus* and those from apple as *malinellus*.

President R. A. Cooley: We will pass to the next paper by Mr. Garman.

NOTES ON THE LIFE-HISTORY OF LASPYRESIA MOLESTA BUSCK

By Philip Garman, *College Park, Md.*

(Withdrawn for publication elsewhere)

President R. A. Cooley: If there is no discussion we will pass to the next paper on the program, "The Calcium Arsenates and Their Efficiency as Insecticides," by Mr. Lovett, of Oregon.

THE CALCIUM ARSENATES

By A. L. Lovett, *Entomologist, Oregon Agricultural Experiment Station*

Introduction

The value of the lead arsenates as a stomach poison for insects has been thoroughly established for the past two decades. Just now the general advance in price on all commodities due to the war conditions has affected this material as well and the report is current that the available supply of lead arsenate is limited. This condition makes necessary the development of an efficient and practical substitute.

Calcium arsenate has long been recognized as a cheaper material than the lead arsenate, but though numerous sporadic tests have been undertaken the general conclusion has been that the material is unsatisfactory because of too frequent excessive burning. The prevailing conditions have revived the interest in calcium arsenate and a number of investigators, including ourselves, have begun a study of these materials.

One of the larger commercial spray manufacturing companies estimates the annual production of lead arsenate for spray purposes at 30,000,000 pounds. This makes the annual cost to the grower about $3,600,000 for their poison spray. Calcium arsenate, in which the comparatively cheap lime is substituted for the expensive lead, can be obtained at one-half the cost of the lead arsenate or effect a saving of $1,800,000 annually. This estimate is based on pre-war prices and the difference in favor of the calcium arsenate should be even greater now.

An analysis of commercial samples of calcium arsenate gave a very high water soluble arsenic content, and as with most arsenical sprays the cause of burning is largely due to the action of the arsenic on the

foliage. This same difficulty was encountered in the earlier attempts to use lead arsenate and it was therefore assumed that, as with the latter, a more complete knowledge of the properties of calcium arsenate, its composition and preparation, might lead to some practical method for its substitution for the more expensive lead arsenates.

The calcium arsenates which would prove of any practical interest from an insecticidal point of view must have certain physical and chemical properties, including a reasonable stability. A study of the commercial calcium arsenates, including some supposedly high grade c.p. salts intended for reagents, indicated that without exception they were mixtures of two or more calcium salts, no two of which were alike in composition.

Believing that the only possible method to properly study the properties of the calcium arsenates for the purpose of determining their value as an insecticide and to establish any reliable data from which sound conclusions may be drawn as a basis for future work is to prepare the pure salts, this study was first undertaken.

Calcium Arsenates Prepared

The chemical work in connection with this project was outlined and developed in its entirety by Mr. R. H. Robinson, Assistant Chemist at the Oregon Station, and a manuscript detailing the work and results has been submitted to the *Journal of Agricultural Research*. This will be published probably in April and to comply with the spirit and letter of the regulations concerning matters submitted there, an attempt will be made simply to summarize some of the essential details of this work.

Two calcium salts, the acid calcium arsenate and the neutral or basic calcium arsenate, known respectively as $CaHAsO_4$ and $Ca_3\ (AsO_4)^2$ were prepared in the pure form, both of which give much promise as insecticides. The chemical and physical properties of the two salts, including the specific gravity, solubility and relative stability were determined. The specific gravity and fineness of division, physical properties so essential in a powdered spray to permit of the efficient spread on foliage and a suspension for a reasonable time in solution, were found to be satisfactory. Both materials when subjected to severe tests were found to be somewhat soluble. The calcium hydrogen or acid arsenate is decidedly soluble, approximating the amount shown by field tests to cause serious burning and indicating that this salt should not be used alone as a spray. The tricalcium, neutral or basic arsenate is only slightly soluble and would appear to be a safe spray material to use alone. From the standpoint of stability, the basic arsenate again showed to an advantage while the acid arsenate proved very unstable, permitting the formation of harmful amounts of soluble arsenic.

Excess Lime or Lime-Sulphur Render Materials Safe

Considered from a practical standpoint it is evident that if some substance could be added to the spray which would prevent solubility and reactivity it would prove beneficial in the use of neutral calcium arsenate, $Ca_3(AsO_4)^2$, and absolutely essential if acid calcium arsenate, $CaHAsO_4$, were to be rendered safe as a spray solution. Ordinary quicklime, CaO, should fulfill the requirements, the $Ca(OH)^2$ becoming soluble reacting with any arsenic going into solution forming more calcium arsenate. As with the previous cases this proposition was subjected to a variety of elaborate chemical tests and the conclusion, following a careful analysis of the results, is that wherever CaO is present in even slight excess so that $Ca(OH)^2$ may be found qualitatively in solution, no soluble arsenic will occur. One precaution must be observed here; be sure the lime is CaO and not $CaCO_3$ as this latter material reacts very slowly with the calcium salts and does not prevent the formation of soluble arsenic. If one part of CaO is added for an equal amount of either acid or basic calcium arsenate in the solution, no burning of foliage should result from the spray due to the formation of soluble arsenates.

Because of the desirability of combination sprays, studies of the calcium arsenate-lime-sulphur mixture were undertaken. Following the reports of G. E. Sanders (1) as included in the proceeding of the Entomology Society of Nova Scotia for 1916 and in communications from him on the success of the calcium arsenate-lime sulphur combination under field tests, more elaborate experiments with the pure materials in dilute lime-sulphur solutions were conducted.

The tests were in all cases favorable beyond expectation. In addition to the pure salts, commercial calcium arsenates consisting of a mixture of $CaHAsO_4$, $Ca_3(AsO_4)^2$, $CaCO_3$ and other materials were tested with the lime-sulphur. With all the materials no chemical reaction occurred and all the constituents remained constant. These tests included samples of the dry lime-sulphur now on the market which likewise was apparently a safe combination. A careful review of the article by W. M. Scott (2) on arsenate of lime would indicate that the absence or presence of lime-sulphur in the solution was correlated with the presence or absence of burn.

Analyzed for total arsenic it was found that the calcium salts contain more than twice as much of the active killing agent as do the corresponding pure lead salts. Theoretically then for spraying purposes only one-half as much calcium arsenate is required as of the lead arsenate. This point requires more elaborate experimentation. Preliminary laboratory tests with sprayed foliage, using a total of 50 tent caterpillars for each spray, indicated a very high toxicity, particularly for the

$CaHAsO_4$. Commercial samples in this test did not compare so favorably. There would appear to be a considerable dilution of the arsenates here. It is believed that this dilution of the commercial samples was in an endeavor to reduce the burn and not an attempt to adulterate the spray material. F. E. DeSellem (5) of North Yakima, Washington, reports in 1916 very favorable results against codling moth with a commercial calcium arsenate. At a dilution of half pound to 50 gallons he obtained a total of 99.5 per cent clean fruit.

Field Tests

Field spraying experiments have been undertaken by several investigators with varying degrees of success. A fairly elaborate series of tests were outlined at the Oregon Station, but due in part to unfavorable weather conditions and in part to war emergency entomological activities, the experiment finally resolved itself into a rather preliminary test of pure and commercial calcium arsenates alone and in combination.

The following materials and combinations were used:

Neutral-calcium arsenate	$Ca_3(AsO_4)^2$
Acid calcium arsenate	$CaHAsO_4$
Calcium ammonium arsenate	$CaNH_4\ AsO_4$
Latimers calcium arsenate	Commercial
Riches Piver calcium arsenate	Commercial

These materials were used alone and in combination with an excess of CaO and of lime-sulphur at strengths of 2-50, 1-100, and 1-400. For example, neutral calcium arsenate was used as follows:

1.	$Ca_3(AsO_4)^2$	2–50 = (at the rate of 2 pounds to 50 gallons)
2.	"	2–50 plus lime 1–50
3.	"	2–50 plus L.S. 1–40
4.	"	1–100
5.	"	1–100 plus lime
6.	"	1–100 L.S.
7.	"	1–400
8.	"	1–400 plus lime
9.	"	1–400 plus L.S.

The trees were six-year-old apple and all materials were applied in duplicate—the date of application was June 15. Observations on burn were made, June 19, June 22, June 27, July 2, and July 18.

A mass of notes were compiled from these field tests but are not deemed sufficiently conclusive from this preliminary experiment to warrant taking time for more than a brief summary:

1. The commercial materials showed decidedly better adhesive properties than did the pure materials.

2. The check trees, those without the addition of either lime or of lime-sulphur, gave a decided burn, accumulative in action.

3. The addition of lime or of lime-sulphur materially reduced the burn and usually prevented serious burn entirely.

4. The addition of lime-sulphur did not afford as perfect protection from burn as did the lime.

It is a matter of common observation that lime-sulphur used in mid-season, even at a very high dilution on foliage which has not been sprayed previously that season with lime-sulphur, will sometimes give a serious burn. Likewise scab areas are found to afford a ready spot for the beginning of spray burn and in our tests it was evident that spray injury was most usual at such points and spread in all directions from the edges of the scab area. Another factor which appeared to be of equal importance in determining the probability and seriousness of the burn with a questionable spray was the natural vigor of the tree. Vigorous trees with large dark leaves seemed much more resistant to burn. Or to state it another way, materials which gave a considerable burn on average trees and on those showing more or less scab infection, in many cases showed no injurious effects when applied to vigorous clean foliaged trees.

Summary

1. The pure calcium salts, $CaHAsO_4$ and $Ca_3(AsO_4)^2$, have been prepared; and the properties essential for use as a spray material tested.

2. Acid calcium arsenate was found to be more soluble and less stable when subjected to unfavorable conditions than was the neutral calcium arsenate.

3. Either of the pure salts or the commercial salts when in solution with an excess of CaO or with lime-sulphur gave no unfavorable reaction and judging from a chemical laboratory test should prove safe spray materials.

4. Care should be observed to ascertain that the lime used is fairly pure CaO and not $CaCO_3$.

5. Preliminary field tests would indicate that a sufficient additional guarantee against burn is secured as to warrant the addition of an excess of CaO in the lime-sulphur-calcium arsenate application.

6. In preparing the solution for field spraying the lime should be slaked and added to the water in proper proportions in the spray tank and the solution agitated vigorously for 15 minutes or more before the calcium arsenate is added.

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President R. A. Cooley: This interesting paper is before you for discussion. Studies of the effectiveness, burning qualities and cost of arsenicals are important, and it is evident that much is left which we might desire in our knowledge of these matters. In Montana, a plant pathologist has for years been studying effects of arsenicals mainly on the apple and has shown, as was published in the *Journal of Agricultural Research*, in his experiment that white arsenic was remarkably non-injurious to the foliage of the apple when sprayed on the trees. Following this, we recently attempted to use white arsenic in spraying potatoes, receiving no injury whatever on the potatoes, when amounts comparable to the amount of arsenic in Paris green were used, and surprisingly not killing the potato beetle, *Leptinotarsa 10-lineata*. We have evidently some things yet to learn about arsenicals.

The next paper is "The Influence of Molasses on the Adhesion of Arsenate of Lead," by Mr. Hartzell, of New York.

THE INFLUENCE OF MOLASSES ON THE ADHESIVENESS OF ARSENATE OF LEAD

By F. Z. Hartzell, *Vineyard Laboratory, New York Agricultural Experiment Station, Fredonia, N. Y.*

The use of molasses in spraying mixtures, for various reasons, has been recommended by certain workers in plant pathology and entomology. During the period from 1910 to 1916 the writer used molasses to make arsenate of lead more attractive to the Rose Chafer (*Macrodactylus subspinosus*) and the grape root-worm (*Fidia viticida*). The success that attended these earlier experiments we believe to have been due to the lack of rain in the period immediately following the application of the material. During 1912, the observations in vineyards sprayed with this combination indicated that failures to secure favorable results against the grape root-worm that season were related to the number of days intervening between the time of spraying and the first rain; *i. e.*, the shorter the time the less perfect the control of the insect. This in turn suggested that the adhesiveness of

sprays might be an important problem to be investigated. It was believed that ordinary foliage tests for adhesiveness were unreliable because of the difficulty of securing quantitative data. To overcome this difficulty the writer devised the following method for making tests of adhesiveness in the laboratory where the various factors might be under control.

Method and Apparatus

The gelatin film which had served as photographic negatives on 5 x 7 glass plates was removed by means of hot water and the glass carefully cleaned by immersion in a sulphuric acid-potassium permanganate bath. Afterwards the plate was washed in hot water and soap and then rinsed in clean water. Between thirty and forty plates were generally used in each series of tests when they were recleaned and used again. Each plate was numbered by means of a series of notches in one edge with a file. This system can be modified by numbering the glasses with diamond ink. In either method the marks are made on an edge or on the surface of the back of the plate. Before a test each plate was weighed on a balance sensitive to one-tenth of a milligram.

The brands of arsenate of lead to be tested were used at the rate of one gram of paste arsenate of lead or .5 gram of dry lead to each 100 cc. of distilled water. The samples requiring molasses had the same amount of arsenate of lead to which was added 2 cc. of molasses to each 100 cc. of water. When the sample was prepared it was carefully stirred to place all material in suspension and 10 cc. of the mixture was removed from the flask by means of a pipette and poured upon the plate, care being taken to spread the material uniformly over the surface. The plate was then placed in a horizontal position and allowed to dry at room temperature (near 68° F.) for twenty-four hours, when it was reweighed. Each plate then received a drenching with ordinary tap water delivered by means of a sprinkling arrangement (described below) whereby the treatment was uniform. They were then placed in a vertical position on a drying rack and allowed to dry for twenty-four hours and, at the expiration of this time, were reweighed.

The washing outfit consisted of a receptacle holding 3.25 gallons of water, tapering to an ordinary shut-off to which a rose sprinkler was attached. This water container was suspended by means of a wire. The distance from the sprinkler to the plates was exactly two feet. Two plates were placed horizontally on a holder in a sink; the water turned on and allowed to flow until the receptacle was empty, which required exactly two minutes. Of course all the water did not strike

the plates but it was found that two plates could be treated at one time with the same precision as one. During the washing the outfit was swung slightly so as to distribute the water equ[illegible] to all parts of the plates. The temperature of the water was [illegible]orded before each washing. In fact every effort was made to have [illegible] tests uniform that the various brands or combinations tested in the several series could be compared. Each brand or combination was tested by treating from two to five plates identically.

We first attempted to spray the mixtures on the plates but found it difficult to apply comparable amounts of material. The question of drying the plates was most perplexing. We first tried drying them in a water jacketed oven, regulated by a thermostat but found this method unsatisfactory. All the plates did not receive the same amount of heat so the upper and lower ones dried first and also there was not the proper air currents to carry off the moisture. This obstacle can be overcome only by means of a change of apparatus, entailing considerable expense so has not been attempted. We might add that drying at room temperature yields fairly accurate results.

Ground glass plates have been substituted for the ordinary ones, thereby simulating, it is believed, the more or less corrugated surface of the leaf but these have shown little advantage over the smooth plates. Glass has been used in all these experiments because of the necessity of using chemicals to thoroughly cleanse the plates before and after each test. It is true that these results are not identical with tests on foliage but they give us a method of comparing the adhesiveness of various substances under identical conditions.

Experimental Results

During the winter of 1912–1913, about 500 tests were made with different brands of arsenate of lead and other insecticides to determine their sticking properties either alone or with other materials. As many of the experiments were conducted with the aim of finding mixtures that would be both attractive and also possess adhesion and since this work is still in progress we will confine our remarks to characteristic tests with arsenate of lead used alone and with molasses. These data are set forth in the following table.

Before discussing this table, we would state that the several plates treated identically in each series gave amounts of material retained that were fairly uniform, so no serious error is introduced by using averages.

From this table we note (1) that the percentage of material remaining on the plates after sprinkling differs considerably with the different

Table Giving Data of Adhesive Tests

Material Applied to Plates	Average Amount of Material on Plates after Drying 24 Hours and before Sprinkling, Grams	Average Amount of Material on Plates after Sprinkling and Later Drying for 24 Hours, Grams	Per cent of Material Remaining on Plates	Number of Plates Used
Brand A, a paste arsenate of lead without molasses	.0587	.0017	2.9	5
Brand A with molasses	.2632	.0012	*2.0	5
Brand B, a paste arsenate of lead without molasses	.0424	.0024	5.7	5
Brand B with molasses	.1452	.0002	* .5	5
Brand C, a paste arsenate of lead without molasses	.0580	.0509	87.8	5
Brand C with molasses	.1611	.0158	*27.2	5
Brand D, a paste arsenate of lead without molasses	.0353	.0140	39.6	3
Brand D with molasses	.1426	.0046	*13.0	3
Brand E, a dry arsenate of lead without molasses	.0479	.0039	8.1	2
Brand E with molasses	.1814	.0047	*9.8	2
Brand F, a dry arsenate of lead without molasses	.0707	.0079	11.2	2
Brand F with molasses	.2070	.0045	*6.4	2
Brand G, a paste arsenate of lead without sugar	.0546	.0089	16.3	3
Brand G with cane sugar	.1564	.0016	*2.9	2
Brand H, a commercial preparation of Bordeaux and lead without molasses	.0501	.0438	87.4	5
Brand H with molasses	.1840	.0016	*3.2	5

*In the tests in which molasses was added we have assumed that the same amount of insecticide was added that was found on the plate of the same brand without molasses and have calculated the percentage retained using this amount as the base.

brands of leads; (2) no dry arsenate of lead proved as adhesive as the better adhering paste arsenate of leads; (3) several of the brands of paste arsenate of lead had poorer adhesive qualities than the brands of dry arsenate of lead tested; (4) in every instance, save one, the addition of molasses to an arsenate of lead lessened its adhesive properties and this decrease in sticking power was greater in some brands than in others; (5) molasses greatly decreased the adhesiveness of a commercial preparation of Bordeaux mixture and arsenate of lead; and (6) cane sugar used in practically the same amount as contained in molasses caused marked lack of adhesiveness in arsenate of lead and therefore we believe that the sugar contained in the molasses is largely responsible for the decreased power of adhesion.

The results just given are of a preliminary nature and further investigation of this problem is planned. However, it is worthy of note that when the same combinations were tested on grape foliage during the period from 1913 to 1916 it was found that any brand of arsenate of lead which showed poor adhesiveness in the laboratory tests also proved to adhere poorly to grape foliage. It was not possible, however, to determine these variations on the leaves with as high a degree of precision as in the laboratory.

Having determined the above facts we were able to secure excellent results with molasses and arsenate of lead for the control of the grape

root-worm by studying the weather indications and applying the spray at a time when there was little probability of rain and also following the first spraying in about one week with an application of Bordeaux mixture and arsenate of lead to act as a repellent to invading beetles which might enter the vineyard during the dispersion period. We therefore suggest that the weather conditions be observed and care exercised to apply the molasses and arsenate of lead mixture at such a time when freedom from rain is to be expected for at least three or four days.

President R. A. Cooley: Do you wish to ask Mr. Hartzell any questions or to discuss his paper? If not, we will pass to another paper by Mr. Lovett, "Spreaders for Arsenate Sprays."

SPREADERS FOR ARSENATE SPRAYS

By A. L. Lovett, *Entomologist, Oregon Agricultural Experiment Station*

The economy of orchard spraying practices is a vital problem today and probably more acute in the northwest than elsewhere. This is due in part to our mild climate, our excessive moisture conditions in the spring and to the narrow margin between profit and loss, requiring a very high percentage of perfect fruit if our crop is to bring returns.

This problem of economics has made necessary a very intensive study of spray materials at the Oregon Station, their combination, relative value and frequency of application and has resulted in a series of papers touching on this question.

The results of the past three seasons as reported by Tartar and Wilson (1) and Lovett and Robinson (2) on the Toxic Values of the Arsenates has lead to the conclusion that we are using our arsenates of lead in more concentrated form than is necessary. Our laboratory experiments indicate that approximately as great efficiency is obtained with acid lead arsenate at a dilution of 1–400 as at 2–50. Allowing for the natural factors which make it impossible to achieve ideal results under field conditions, theoretically a strength of 1 pound of arsenate to 100 gallons of water should give efficient control. In spite of this our growers feel that sufficient additional protection is obtained with the July and August applications for codling moth as to warrant the additional expense of using $3\frac{1}{2}$ pounds to 50 gallons.

A careful analysis of this condition warrants the contention that this apparent discrepancy is due largely to indifferent methods of application under average field conditions. Recent improvements in nozzles, combined with greater pressure, permitting the spray solution

to be applied as a finely divided fog or mist like spray, indicate, in our preliminary tests, a very distinct advance in effectiveness.

Of equal importance in this regard is the development of an efficient spreader which may be added to the arsenate solution. We believe that if a satisfactory spreader can be developed it will be possible to get very effective codling moth control with a dilution of 1 pound of arsenate to 100 gallons of solution. It is a matter of common experience when checking on a sprayed plot for the thoroughness of application to judge largely by the half circles and blotches of dried arsenate deposited more or less irregularly over the sprayed surface. Our conception of an efficient spreader is some material which allows the droplets to so spread out and join one another as they dry that the arsenate finally rests as an even, regular, inconspicuous covering affording a perfect and equal protection for every surface.

Suspension Tests

The surface tension and specific gravity are probably factors of importance in determining the value of a spreader, but so far the correlation of each to the other has not been determined and does not appear to be in a direct proportion. The ability of a liquid to hold arsenate in suspension does appear to be a very fair indication of its ability as a spreader, however. The materials tested, the dilutions and results are given in Table No. I.

One thousand cubic centimeters of each solution was taken, cylinders of uniform size and 1000 cc. capacity were used, and to each solution was added 5 grams of acid lead arsenate; the cylinders were thoroughly and uniformly agitated and the arsenate allowed to settle. Readings were made at the end of 5 minutes, 10 minutes, 2 hours and 6 hours.

Table I—Suspension Tests

Material	Dilution*	Readings of Settled Arsenate				
		5 Min.	10 Min.	2 Hrs.	6 Hrs.	Remarks
Sage tea	1-1000	1 cc.	1.2 cc.	3.6 cc.	6 cc.	Good
Sage tea	5-1000	.7 cc.	.9 cc.	2.8 cc.	4.8 cc.	Very good
Glue	1-1000	.8 cc.	1 cc.	3.4 cc.	6 cc.	Good
Glycerine	5-1000	.6 cc.	.9 cc.	4.2 cc.	7.1 cc.	Good
Gelatine	1-1000	.5 cc.	.6 cc.	2 cc.	3.1 cc.	Excellent
Sugar	5-1000	7.7 cc.	9 cc.	All down		More rapid than water
Honey	5-1000	3.8 cc.	4 cc.	8 cc.	All down	Poor
Gum Tragacanth	1-1000	6.8 cc.	All down			No good
Fish oil soap	1-1000	2.5 cc.	3 cc.	4.8 cc.	All down	Material flocculent
Casein-lime	1-1000	1 cc.	1.6 cc.	3.2 cc.	5.8 cc.	Good
Resin soap	5-1000	3 cc.	3.8 cc.	5 cc.	All down	Poor
Water	......	6 cc.	8 cc.	All down		

* The dilution figures refer to the number of grams or cubic centimeters of material to 1000 cc. of water; 5 grams of acid lead arsenate was added to each solution.

Some of these materials were run a second and even a third time,

but with little variation in the general results. The sugar behaved very peculiarly in actually precipitating the arsenate. The Gum Tragacanth did not go into solution and itself settled down to the lower two-thirds of the cylinder.

On Bean Foliage

A test of the solutions on bean foliage was next made, primarily for burn, but incidentally it gave an indication of great promise for two of the materials as spreaders. Twenty-five pots of a uniform size and containing similar soil were planted to an excess of common navy beans, and placed in the greenhouse to grow. When the plants had attained a fair size, 10 pots were thinned down to a single uniform bean plant and 10 were thinned to two plants and in the following experiment the single plants were used in reduced sunlight, those with two plants were used in direct sunlight. The plants were sprayed on November 14 and observations on burn were made November 19, 24, and 29. The arsenate in all cases was used at a strength of 4.8 grams to 1000 cc. of solution. The materials used and final results are contained in the following table:

Table II—Record of Burn

Materials	Dilution	November 19		November 24		November 29		Remarks
		Direct Sun	Reduced Sun	Direct Sun	Reduced Sun	Direct Sun	Reduced Sun	
Fish oil soap.	1-1000	Medium burn	Slight	No change	No change	Serious	Fair burn	Not suitable
Glycerine . . .	5-1000	Slight	General slight	General	No change	Not bad	No change	Questionable
Glycerine . . .	10-1000	Considerable	No burn	Serious	No change	Serious	Serious	Not safe
Glue.	1-1000	Medium burn	Medium burn	No change	No change	Fairly bad	Not serious	Questionable
Gelatine	1-1000	Slight	No burn	No change	No change	Slight	Trace	Good
Sage tea.	5-1000	No burn	No burn	No burn	No change	No burn	No burn	Excellent
Sage tea. . . .	10-1000	Slight	No burn	Same	No change	Trace	No burn	Excellent
Casein-lime. .	5-1000	Trace	No burn	No change	No change	Trace	No burn	Excellent
Lime-sulphur.	10-1000	No burn	No burn	Slight	No change	Fair	Slight	Questionable
Lime-sulphur.	20-1000	Scattering	Large spots scattering	Spreading bad	No change	Serious	Fairly bad	Not safe
Check		Considerable	Small, general	Spreading, general	No change	Serious	Considerable	

The two materials which gave the least burn, sage tea and the casein-lime mixture, likewise approximated the ideal sought for in a spreader. The casein-lime solution, particularly on the bean foliage, spread out evenly and uniformly, depositing the arsenate in a smooth, even, inconspicuous coating. A similar test of these two materials as spreaders on the foliage of strawberry was made and gave most satisfactory results.

Both of these materials are rather unusual and a short discussion of their preparation should prove of interest.

Sage Tea

The material referred to here as sage tea is the solution obtained by steeping one pound of cut up leaves and stems of our common prairie sage bush of Oregon (*Artemisia tridentata* Nutt.) in one gallon of water. The water is brought to a boil, removed from the fire, the sage added and the vessel covered and allowed to stand for 12 hours or more, when the liquid is drawn off. This sage tea is a brown, oily, emulsion-like solution. The oils and other ingredients present have not been determined but are probably similar to those as given by *Robak* (3) for white sage (*Artemisia frigida* Willd). The preliminary tests of the materials as a spreader so far made are not conclusive but are surely encouraging.

Casein-Lime Mixture

The suggestion of the casein-lime mixture was obtained from an abstract of an article appearing in the Agricultural Gazette of New South Wales, XXIV, pt. 10, p. 868 on spreaders for Bordeaux mixture. The material was mixed as suggested there, the procedure being as follows: To 3.5 grams of quick lime was added 1.5 grams of powdered casein. This material was ground in a mortar to a homogeneous mass. The amount to be added to the solution was then weighed out and by small additions of water and much stirring finally rendered to a thin paste and then added to the general solution. Considered chemically we may call this calcium-caseinate and as nearly as we can determine at present we probably have formed a colloidal solution. The very nature of it, its cheapness, the small amount required and apparently desirable qualities make it a material worthy of much additional study. It is suggested that from 4 to 8 ounces of the mixture to 100 gallons of solution is probably sufficient to obtain the spreading qualities desired.

Literature Cited

(1) Tartar, H. V. and Wilson, H. F. 1915. Toxic Values of the Arsenates of Lead. Jour. Econ. Ent., VIII, No. 5, p. 481.

(2) Lovett, A. L. and Robinson, R. H. 1917. Toxic Values and Killing Efficiency of the Arsenates. Jour. Agr. Research, X, No. 4, p. 199.

(3) Robak, F. 1906. U.S.D.A. Bur. Plant Ind. Bul. 235, p. 21.

If there is no discussion on this paper, I will pass to the next, "A Study of the Toxicity of Kerosene," by Mr. Moore, of Minnesota. Mr. Ruggles will read this paper.

A STUDY OF THE TOXICITY OF KEROSENE[1]

By WILLIAM MOORE, *Head, Section of Research in Economic Zoölogy*, and
S. A. GRAHAM, *Assistant, Division of Economic Entomology*

INTRODUCTION

During the summer of 1916 Marcovitch, assistant in entomology in this division, successfully sprayed a field of potatoes with pure kerosene killing the leaf hoppers, *Jassidæ,* without injuring the potato plants. Sanderson[2] states that "pure kerosene should never be used on foliage, for though occasionally someone will report using it successfully without injury, in almost all cases serious burning of the foliage results."

Kerosene and kerosene emulsions have been in general use as insecticides since the early eighties when the first papers on this subject appeared.[3] Although good results were often obtained, particularly in the use of the emulsions, it is also true that frequently either the insects were not destroyed or the foliage was severely burned.

Where burning has occurred it has been the custom of many entomologists to lay the blame to an imperfect emulsion. The result has been that within recent years the use of kerosene as an insecticide has been largely abandoned in this country. Results obtained in the study of a large series of volatile organic compounds[4] showed that the boiling point, as an index of the volatility, had considerable influence on their toxicity to insects. With these results in mind it was considered that a study of the toxicity of kerosene to both plants and insects would be of value in clearing up the irregular results frequently obtained in using this material.

KEROSENE

Kerosene is the name applied to an oil intended for burning purposes. It usually consists of those fractions of petroleum distilling over between 150° and 300° C. and is required by law to meet a certain flash test. Even from the same source such an oil may vary consid-

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[1] Published with the approval of the Director, as Paper No. 93 of the Journal Series of the Minnesota Agricultural Experiment Station.

[2] Sanderson. Insect Pests of Farm Garden and Orchard, p. 49. John Wiley & Son, Pub., New York, 1912.

[3] Riley, C. V. Rpt. of Ent., Ann. Rpt. Dept. of Agr., 1884; Rpt. of Ent., Ann. Rpt. Dept. of Agr., 1886. Hubbard, H. G. Scale Insects of the Orange, Remedies and Application. Rpt. of Ent., pp. 106–126 from Rpt. of Dept. of Agr., 1882.

[4] Moore. Toxicity of Various Benzene Derivatives to Insects, Jour. of Agr. Research, vol. 9, No. 11, 1917; Volatility of Organic Compounds as an Index of their Toxicity to Insects, Jour. of Agr. Research, vol. 10, No. 7, 1917.

erably in composition due to its manner of preparation. Some are placed on the market directly as they are obtained in distillation, while others are further purified. Some consist of heavy oils which have been diluted with naphtha to give them the proper flash point, while others are heavy oils which by a special process of distillation known as cracking are broken up into oils having a lower boiling point, thus enabling them to pass the flash test. In addition to these and other types of kerosenes which may be obtained from the same source there might be mentioned an almost endless number of variations depending upon the source. The petroleum obtained from the fields of Pennsylvania, Illinois, Indiana, Texas, California, Canada, Russia, and other places, to which may be added the Scotch shale oil known as paraffin oil in England, all vary to some extent in their chemical composition. Not only do they vary in minor constiuents but even as to the series of chemicals which they contain such as the Pennsylvania oil with its paraffin base and the California oils with their asphaltic base. With these variations in mind five different oils were obtained for this study. Two of these were obtained from the same field but were decidedly different oils while the other three represented different oil fields. Only American oils were used as it is doubtful if foreign oils are usually encountered on the American market. The oils may be conveniently referred to as A, B, C, D, and E; A and B representing oils from the same field but differing in that A was more refined and a more expensive oil than B. C, D and E represented oils from other fields. These oils were all fractionally distilled into four parts with the idea of obtaining compounds of a more even chemical composition and with a smaller range of boiling points. Table I shows the different boiling points of the fractions and the per cent of each fraction to the whole.

TABLE I

Oil	First Fraction		Second Fraction		Third Fraction		Residue	
	Boiling Point	%	Boiling Point	%	Boiling Point	%	Boiling Point	%
A	140°–187°	27.2	187°–234°	42.6	234°–280°	28.2	280°+	1.9
B	160°–200°	19.5	200°–240°	57.7	240°–280°	21.0	280°+	1.7
C	135°–183°	11.1	183°–231°	66.6	231°–280°	22.2	....	...
D	150°–195°	20.0	195°–240°	60.0	240°–285°	20.0	....	...
E	150°–185°	37.4	185°–235°	46.0	235°–260°	12.2	260°+	4.4

RESULTS OF EXPERIMENTS

Toxicity to Plants

The toxicity to plants was tested by spraying tomato plants, in the

greenhouse under similar temperature and light conditions, with the unfractionated oils, the different fraction of these oils, and the oils and fractions emulsified with soap and applied at various strengths. These oils were all emulsified using the Riley-Hubbard formula with ivory soap as the emulsifier.

Results of spraying with the pure oils and emulsions of these oils are given in Table II. From these data it is evident that different

TABLE II

Name of Oil	Applied	Unfractionated	First Fraction	Second Fraction	Third Fraction
A	Pure	4(2)	5(4)	4(3)	4(1)
A	25%	1(2)	1(2)	1(3)	2(3)
A	10%				
A	5%				
A	3%				
B	Pure	4(6)	4(5)	5(4)	5(5)
B	25%	4	4	4	4
B	10%	3	3	4	4
B	5%	2	2	3	4
B	3%	3	2	3	3
C	Pure	5(5)	5(6)	6(5)	6(3)
C	25%	4(3)	3(2)	4(2)	5(3)
C	10%	3	3	4	4
C	5%	2	2	3	3
C	3%	3	2	3	3
D	Pure	5(4)	5(5)	6(4)	4(3)
D	25%	4	3	4	4
D	10%	4	3	4	4
D	5%	2	2	3	4
D	3%	2	2	2	4
E	Pure	5(2)	6	5	3
E	25%	2	2	2	3
E	10%	2	2	2	1
E	5%	2	1	2	2
E	3%	1	1	1	1
A	5% diluted with hard H_2O	2	3	3	2
D	5% diluted with hard H_2O	3	3	4	4

1—Uninjured. 2—Very slightly injured. 3—Slightly injured. 4—Injured. 5—Seriously injured. 6—Dead. Figures in parenthesis are the results of preliminary experiments carried out under varying conditions of light and temperature and illustrate how results may vary with varying conditions.

brands of kerosene differ in their toxicity to plants, and further that there is a difference in the action on plants of the various fractions of the same brand. In using the pure oil it may be noted that the lowest fraction in general injured the plants less than the second fraction, but the second fraction produced as a rule greater injury than the third fraction. In the experiments it was noted that the first fraction, containing the oils with low boiling points, penetrated the leaves very quickly and the injury was noted very much sooner than with the

higher fractions. In some brands, notably E, the injury from this fraction was greater than from any of the other fractions. In considering the emulsions it is apparent that the soap protected the plants from the most volatile portions until such time as it had evaporated, hence in emulsions the lower fractions of the oil were less injurious than the higher fractions which remained on the plants so long that they had an opportunity to penetrate after the emulsion had dried out. Some kerosenes can be used at a relatively high concentration with little or no injury to the plants, while other brands produce injury when as dilute an emulsion as 3 per cent is used. This is more interesting in that A and B, kerosenes from the same field, showed this decided difference. This is possibly due to impurities in B which are not present in the more highly refined A. The influence of using hard water in diluting the emulsion resulted in a greater injury to the plants than the spray of the same strength diluted with distilled water.

The Toxicity of Vapor of Kerosene

Inasmuch as Shafer[1] considers that it is the vapor of kerosene and similar compounds which kills insects when used as a contact spray, a study of the vapor of the different brands and their fractions was made.

In testing the vapors the house-fly, *Musca domestica* Linn., was used. The flies were placed in flasks and the amount of material required to kill them in 400 minutes was determined as described in previous papers by one of us.[2] The results are shown in Table III.

Table III—Number cc. of Oil per Liter Required to Kill in 400 Minutes

Oil	Unfractionated	First Fraction	Second Fraction	Third Fraction
A	.006237	.004158	.004752	*
B	.005454	.00297	.003267	*
C	.00594	.00297	.001782	*
D	.005346	.003584	.003584	*
E	.006534	.003861	.00297	*

* Not killed in 400 min. in saturated atmosphere.

From this table it is evident that only the lower fractions are capable of killing the insects, the higher fractions not being sufficiently volatile to produce sufficient vapor to kill at ordinary temperatures.

The amount of liquid of the second fraction which was necessary to kill the insects was far in excess of that which would volatilize and

[1] Shafer, G. D. How Contact Insecticides Kill, I and II. Tech. Bul. Mich. Agric. Exp. Sta. Bul. 11, 1911.

[2] Moore. Loc. cit.

apparently death was due to only the portions of this fraction with the lowest boiling points. From these results it would appear that only the lowest fractions of kerosene would be effective when it is used as a contact insecticide.

Toxicity of Kerosene Emulsions to Insects

To determine the accuracy of this point different kerosenes and their fractions were used in a 5 per cent emulsion as a spray for the destruction of the snowball aphis, *Aphis viburnicola* Gillette. These are sprayed with a 5 per cent emulsion of the oils and their fractions. The aphids were counted before and after spraying to determine the per cent killed. Results of these experiments are shown in Table IV.

These data show decidedly contrary results to what might be expected. *The higher fractions were in all the oils most toxic.* As a check snowball aphids were sprayed with a soap solution of the same strength as that used in the 5 per cent emulsion with the result that only 30 per cent of the aphids were killed. The effectiveness of the high boiling point fractions cannot be due to the soap in the emulsion nor can it be due to any influence on the penetration of the oils or the lower boiling points would also have shown this influence. It would appear, therefore, that the death of the insects from high boiling point compounds is not due entirely to the vapor. This matter is being investigated and will be reported later.

Table IV—Per Cent of Aphids Killed by a 5 Per cent Emulsion

Oil	Unfractionated	First Fraction	Second Fraction	Third Fraction
A	81.5	56.5	94	90
B	74	66.66	100	100
C	90	66.66	77	100
D	90	90	76	96
E	80	60	89	100

Conclusion

The results of these experiments point out conclusively the great variation in the toxicity of different types of kerosenes to both insects and plants. Although an imperfect emulsion would naturally result in injury to plants, it by no means follows that where burning does occur that it is always due to an imperfect emulsion. The cause of the burning may be entirely due to the type of kerosene used. So great is the difference between kerosenes that it is quite possible to use certain types of kerosene *pure* upon certain plants under favorable climatic conditions. Inasmuch as kerosenes even of the same brand

no doubt vary from time to time in their physical characteristics and chemical composition the use of kerosene is always uncertain. The results, however, show that kerosenes of considerable value as insecticides and of very slight toxicity to plants can be manufactured. They should, however, be manufactured for the particular purpose of insecticides to meet an insecticide test rather than a flash test.

SUMMARY

1. Kerosene varies greatly in its physical characteristics and its chemical composition, even when coming from the same oil field.
2. Low boiling point fractions of kerosene are in general more toxic to plants than high boiling point fractions when used pure.
3. Injury by fractions with low boiling points can largely be prevented if they are applied in the form of an emulsion, since the emulsion holds the oil away from the plant until such time as it has evaporated.
4. Emulsification of high boiling point fractions does not give this protection since the oil remains on the leaf after the emulsion is destroyed.
5. Low boiling point fractions are more toxic to insects in the form of vapor than high boiling point fractions due to the slight volatility of the higher fractions.
6. High boiling point compounds are more toxic than low boiling point compounds when used as contact insecticides in the form of an emulsion.

PRESIDENT R. A. COOLEY: I will call for the next paper, "Insecticide Tests with *Diabrotica vittata*," by Mr. Howard, of Wisconsin.

INSECTICIDE TESTS WITH DIABROTICA VITTATA

By NEALE F. HOWARD, *Madison, Wis., Specialist, Bureau of Entomology, Truck Crop Insect Investigations.*[1]

The rôle which insects play in the transmission of certain serious plant diseases makes the control of the species involved of even greater economic importance than heretofore. During the course of investigations into the control of insects which transmit cucurbit diseases, especially the mosaic disease, the use of stomach poisons received some attention.

A trial was made on a large scale in 1916, at Madison, Wisconsin, to control the mosaic disease by controlling the striped cucumber

[1] Published with the permission of the Chief of the Bureau of Entomology.

beetle, which was supposed to be one of the chief factors in the dissemination of this disease. Bordeaux mixture 2–4–50, with lead arsenate paste 4–50, was applied to all cucurbits in an isolated area. Eleven acres were treated every 7 to 10 days during the first half of the season. The beetles were extremely abundant.

It soon became apparent that the control of the beetle was far from perfect, and we could notice no lessening of the destructive mosaic disease. A number of experiments were then started, with the purpose of obtaining definite data on the efficiency of the spray. Some insecticides which had been tried in a small way in the field, and which showed no injury to the plants, were also included. The results were checked during the past season.

To ascertain the percent efficiency of the Bordeaux-lead arsenate in the field, a number of beetles were collected from young squash plants immediately before spraying for the first time and twenty-four hours later. After ten days, 10 of 102 beetles collected before spraying had died, while 25 of 93 beetles collected after spraying had died. The per cent mortality of each was respectively 10.8 and 36.77, or about 26 per cent efficiency of the spray. This was surprising, for Bordeaux-lead-arsenate had been recommended for the control of the striped cucumber beetle.

A series of tests were then conducted in large cages, wooden frames and cloth top and sides, the latter with sleeves for head and arms to make handling convenient and eliminate losses. The cages were placed over single plants in the field, and a heavy muslin cloth was sewed about the stem of the plant and tacked to the sides of the cage to prevent the beetles from burrowing in the soil. A small compressed air atomizer, capacity one quart, was used in the spraying. It was aimed to cover the plants completely, a practice hardly possible under field conditions. All blossoms were plucked because of the avidity of the species for flowers, which could not be sprayed thoroughly. The beetles were left on the sprayed plants for twenty-four hours unless otherwise noted, and were then removed to Riley cages and observed daily for five days. Each cage contained 100 beetles and a check was run with each experiment. The beetles were collected from untreated fields. In most instances the living and dead beetles were counted when removed from the plants, and again at the close of the experiment. Table I gives the results of the experiments carried on in 1916.

In 1917 two experiments were performed in a similar manner but new cages of special construction were used and the losses of the active beetles in handling were greatly reduced. The cages were constructed as follows: a frame 2 feet wide, 2 feet high, and 3 feet long

TABLE I—5 EXPERIMENTS WITH 9 INSECTICIDES—11 TESTS

100 Beetles per Test. Check of 100 beetles per experiment. Beetles on plants 24 hours unless noted. Live beetles counted at beginning and end of experiment

Date 1916	Insecticide	Rate per 50 Gal.	5 Days after Put on Plants, Total		Total Killed by Insecticide (% Efficiency)
			Alive	Dead	
July 28	Lead arsenate paste	4	37	45	41
	Check		91	4	
Aug. 2	Bordeaux-lead-arsenate	2-4	93	1	0
	Check	4-	91	1	
Aug. 3	Calcium arsenate powder	2	59	13	1
	Check		84	12	
Aug. 11	Check	2-4	97	0	
	Bordeaux-lead-arsenate	4-	87	2	2
	Lead arsenate paste	4	90	6	6
	Sweet lead arsenate	4	85	13	13
	Paris green	1	77	20	20
Aug. 14 †	Check		*92	5	
	Cobalt arsenate paste	2	92	8	3
	Zinc arsenate powder	2	80	19	14
	Zinc arsenite powder	2	65	26	21
	Arsenic bi-sulphide	2	94	3	-0

* After four days.
† On plants 48 hours.
NOTE: Beetles killed by parasites counted as living. Beetles which escaped in handling also counted as living.

was covered on three sides and top with 20 mesh pearl wire. The fourth side was covered with heavy muslin, in which were sewed three sleeves placed in the proper positions to enable one to insert his head and arms and work with ease. The bottom was covered with heavy muslin which had been sewed about the plant.

The insecticides were used in different proportions, however, the aim being to have approximately equal amounts of arsenic pentoxide per unit of spray. Lead arsenate was used in the same proportion as in 1916, but Paris green and zinc arsenite were varied to suit, so that the former was used at the rate of 1 to 60, the latter at 1 to 40. Fish oil soap was used in each test of July 6 except in the case of the sweetened lead arsenate, at the rate of 2 pounds to 50 gallons. Chemical analyses of the insecticides showed them to be representative of the preparations on the market.

The poisoned bran mash used was made according to Farmer's Bulletin No. 747, but pulp of muskmelon was substituted for other fruit. The results of these experiments are given in Table II.

The general average of all tests gives, I believe, a very good idea of the relative value of these insecticides in the field, and what one might expect when the repellent properties of Bordeaux mixture are considered. It is true that all these insecticides are more or less repellent. This has been determined in a different series of experiments which are not recorded here. The general average may be

TABLE II—2 EXPERIMENTS WITH 12 INSECTICIDES—12 TESTS

100 beetles per test. Check of 100 beetles per experiment. Beetles on sprayed plants 24 hours. Living beetles counted at beginning and end of each experiment, dead beetles counted every day. Summary given in table

Date 1917	Insecticide	Formula	5 Days after Put on Plants, Totals		Total Killed by Insecticide (% Efficiency)
			Alive	Dead	
July 6	Lead arsenate, wet	2 lbs. Pwdr. 50 Gal.	77	24	10
	Lead arsenate and molasses	50 Gal. 9 qt. Mol.	63	38	24
	Lead arsenate and Bordeaux	2-50 2-4-50	48	48	34
	Zinc arsenite, wet	1 lb. Pwdr. 40 Gal.	48	49	35
	Bran mash		24	74	60
	Paris green	1 lb. to 60 Gal.	49	43	29
	Check		87	14	
Aug. 10	Lead arsenate, wet	Same as above	85	15	10
	Lead arsenate and molasses		81	18	13
	Lead arsenate and Bordeaux	Same as above	84	10	5
	Zinc arsenite, wet	Same as above	80	20	15
	Lead arsenate, dust	1-3 Lime	85	14	9
	Paris green, wet	1-60	87	5	0
	Check		95	5	

misleading in one respect, for sweetened lead arsenate is more effective than indicated. However, in the field, where most of the above insecticides were given a thorough trial on a good acreage in 1917, the results were not noticeably different than with any of the others, although sweets have been shown to be attractive in other experiments. The poisoned bran mash is not included in this summary, since subsequent tests showed that even sprayed plants were more attractive. The average of the two seasons' results is as follows:

Zinc arsenite, average of 3 tests	24% efficient
Lead arsenate, average of 4 tests	17% efficient
Sweetened lead arsenate, 3 tests	17% efficient
Paris green, average of 3 tests	16% efficient
Zinc arsenate, 1 test	14% efficient
Bordeaux lead arsenate, 4 tests	14% efficient
Lead arsenate dust, 1-3, 1 test	9% efficient
Cobalt arsenate, 1 test	4% efficient
Calcium arsenate, 1 test	1% efficient
Arsenic bi-sulphide (Realgar), 1 test	0% efficient

Zinc arsenate is too unstable, in its present commercial form, at least, to be of importance. Cobalt arsenate needs no further comment. Arsenic bi-sulphide is too heavy to stay in suspension and does not spread well. This fact no doubt accounts for its poor showing. Zinc arsenite is apparently more effective than arsenate of lead.

The fact that a higher per cent efficiency was indicated by collec-

tions before and after spraying in the field, than in the tests is easily explainable by the fact that the beetles had recently emerged when the collections were made, and were feeding indiscriminately. The seasonal life history of *Diabrotica vittata* must be kept in mind in interpreting all of these tests.

It is evident, as has been mentioned by others, that *Diabrotica vittata* is difficult to poison. In cases where Bordeaux mixture is of value in controlling plant diseases, it may be used to advantage with lead arsenate or preferably zinc arsenite. Under conditions which prevail in the cucumber growing sections of the North Central States, its value as a control of the striped cucumber beetle does not warrant the expense of application.

PRESIDENT R. A. COOLEY: Do you wish to discuss this interesting and valuable paper? If not, we will pass to the next paper, "The Imported Cabbage Worm in Wisconsin," by Mr. Wilson and Mr. Gentner, of Madison, Wis.

THE IMPORTED CABBAGE WORM IN WISCONSIN

By H. F. WILSON and L. G. GENTNER,
University of Wisconsin, Madison, Wis.

There is a general belief among Wisconsin canners and growers that it is dangerous to use cabbage that has been sprayed with poisons of any kind. Both canners and growers recognize the fact that the cabbage worm is a serious pest but the growers have not been free to use essential combative measures because they consisted of spraying with arsenicals.

Other investigators have already shown that cabbage sprayed with arsenicals may be eaten without danger to the consumer but in order to more thoroughly convince Wisconsin growers of these facts, the investigations from which the included data was secured were planned.

The life-history work of two seasons has shown that there are three distinct generations each year and sometimes a partial fourth. There is normally more or less overlapping of generations, especially toward the latter part of the season. The maximum emergence of adults from overwintering chrysalids occurs somewhere from the first to the middle of May, depending upon the season. The maximum emergence of adults of the first generation occurs during the first two weeks of July; and of the second generation during the first two weeks of August.

In the southern half of the state generally speaking, both early and late cabbage are grown while only late cabbage is grown in the northern sections. The early cabbage usually matures without much injury from the cabbage worm, but the late cabbage is often seriously injured and as many as 35 per cent to 40 per cent of the heads may be made unfit for market. In very severe cases entire fields are wiped out. In the northern half of the state the late cabbage sometimes matures in good condition without a single application of spray while at other times the losses are very serious.

In the experiments carried on at Madison during the past year the following insecticides were used: Paris green, lead arsenate (powder and paste), zinc arsenite, calcium arsenate (powder and paste), tobacco dust and finishing lime. When applied in the liquid form the sprays were applied at the rate of one pound of the powder or two pounds of the paste to fifty gallons of water. The following materials were used as "spreaders" or "stickers": common yellow laundry soap (resin) at the rate of one or two pounds to fifty gallons of spray; molasses at the rate of one or two quarts; and molasses and lime at the rate of two quarts of molasses and three pounds of lime to each fifty gallons of spray used. When applied as a dust spray, the materials were diluted from three to ten times by weight with lime.

The results of the experiments showed that Paris green (this was used only in liquid form), lead arsenate and calcium arsenate gave entirely satisfactory control, while, contrary to expectations, zinc arsenite failed to give control in any of the four plats to which it was applied. In fact some of the plats sprayed with zinc arsenite were practically as severely injured as the unsprayed check plat. In comparing the liquid sprays with the dust sprays, results showed that the liquid sprays gave slightly better control than the dust sprays due to the fact that the latter were more easily washed off by the heavy dews and rains. Tobacco dust and lime seemed to have practically no effect upon the cabbage worms.

Common laundry soap used with the liquid sprays at the rate of one pound or more to fifty gallons gave far better results than where either molasses alone or molasses and lime were used, due to the more even distribution of the poison in the case of the former.

From one to two applications of spray are generally used to combat the cabbage worm. Ordinarily one application made a week or ten days after the butterflies appear in large numbers in July and another in August will give satisfactory control.

In order to determine whether or not there is any danger of poisoning to the consumer from the use of arsenicals, one head from each of six sprayed plats and one head from the check plat were analyzed by

WHY CABBAGE PLANTS SHOULD BE SPRAYED

Head from sprayed plat B. Average head from adjoining unsprayed plat

WHY CABBAGE PLANTS SHOULD BE SPRAYED

A. Sectional view of spray protected plant

B. Sectional view of unsprayed plant showing destruction of leaves which would normally form friction cap

the Agricultural Chemistry Department of the University. The plats from which these heads were taken had received five sprayings, the last spray having been applied about a week before picking. In preparing the heads for analysis, only the outer leaves were removed as is done by the grower, then one more layer of leaves was removed to correspond to those taken off by the housewife. Not even a trace of arsenic was secured in the analyses.

Inquiries have been made with regard to feeding the outer leaves to stock, therefore an analysis was made of the outer leaves of three plants, two taken from the plats sprayed five times with lead arsenate and Paris green respectively and one sprayed twice with calcium arsenate. The results of the analysis were as follows:

Plant sprayed with lead arsenate	56.7	mgms.	AS_2O_3
Plant sprayed with Paris green	22.8	mgms.	AS_2O_3
Plant sprayed with calcium arsenate	1.25	mgms.	AS_2O_3

These are large quantities of arsenic and would undoubtedly poison stock. The fatal dose of arsenic for mature man varies from 8 to 20 mgms.

Conclusions: While Paris green gives efficient control the cost is too high for economical use. Lead arsenate and calcium arsenate at the rate of one pound of the powder or two pounds of the paste to fifty gallons, with the addition of one pound or more of common laundry soap, give efficient control and are the most economical to use.

The failure of zinc arsenite to control the cabbage worm is not understood and further experiments will be made.

No trace of arsenic was found to be present on sprayed heads prepared for cooking even when sprayed as late as a week before picking. The outer leaves may carry enough arsenic to poison stock and are therefore dangerous to use for that purpose.

PRESIDENT R. A. COOLEY: Do you wish to ask any questions of Mr. Gentner, or discuss his paper? If not, the next paper is, "Poisoned Bait Experiments with the Onion Maggot," by Mr. Neale F. Howard, Madison, Wis.

POISONED BAIT FOR THE ONION MAGGOT

By Neale F. Howard, *Madison, Wis.; Specialist, Truck Crop Insect Investigations, Bureau of Entomology*[1]

During the past two years many inquiries have been made concerning the poisoned bait spray as a remedy against the onion maggot, *Hylemyia antiqua* Meigen[2] (*Pegomyia* (*Phorbia*) *ceparum*, P. *cepetorum*). The writer therefore thought it advisable to give at this time a brief summary of the work performed along this line in 1915 and 1916.

The poisoned bait as a control for the onion fly was tested in an experimental way at the Wisconsin Agricultural Experiment Station in 1913, under the direction of Professor J. G. Sanders. The results obtained in this preliminary work at Racine, Wis., by Dr. H. H. P. Severin were promising.

In 1914 growers from different parts of the state reported favorable results from the use of the spray to Professor Sanders. The infestation that year was lighter than in most years, however. In 1915 the writer was stationed at Green Bay, Wis., for five months to investigate the remedy, working for the Bureau of Entomology under the direction of Professor Sanders and Dr. Chittenden. In 1916 the writer returned to Green Bay for six weeks to repeat the trial, under the direction of the Bureau of Entomology.[3]

In 1915 the poisoned bait was applied to seven acres of onions on one farm, where the writer made his headquarters, and to a slightly smaller acreage on four neighboring farms. Applications were made with a small compressed air sprayer, altered to give a coarse spray (Pl. 3, fig. 1). The operator walked up and down the fields, about every 15 or 18 feet, and released a quantity of spray every four paces. In this manner about three gallons were applied to the seven acres on the average of twice a week, weather permitting, as soon as the onions came up until the latter part of June. In the latter part of May the amount of spray applied was doubled. The bait was mixed according to the Sanders formula, as follows: 5 grams (about 1/6 ounce) of sodium arsenite, dissolved in boiling water; one-half pint of molasses; one gallon of water.

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[1] Published with the permission of the Chief of the Bureau of Entomology.

[2] Stein, in "Katalog der Palæarktischen Dipteren," Vol. 3, places *ceparum* Meigen (1830) and *cepetorum* Meade (1883) in synonymy with *Hylemyia antiqua* Meigen (1826). This fact, together with the practice of European entomologists of designating the onion fly by the latter name, makes it advisable, in the writer's opinion, to adopt it in the United States.

[3] The writer desires to acknowledge the coöperation of the Department of Economic Entomology, University of Wisconsin, and of the firm of Smith Brothers, Green Bay, Wisconsin.

By the first week in June the maggots were doing much damage to the young onions, and by the end of June the infestation was serious. Apparently no benefits whatever had accrued from the use of the poisoned bait, and the application was discontinued. One field of three acres showed a 75 per cent infestation, others 50 per cent or less.

During the next eight weeks a series of fly trap experiments were performed to ascertain the attractiveness of various baits, and to determine the killing properties of the poison. In these experiments 14 baits were used. Over 12,000 adults of the three species of root maggots prevalent in the locality were trapped, examined, and counted. The males were determined specifically, but the females were counted *in toto*. The total, 12,084, showed 59.4 per cent or 7,176 females, and 40.6 per cent or 4,908 males, of the species *Hylemyia antiqua*, *Phorbia brassicæ*, and *Pegomyia fusciceps*.

Of the baits used, Sanders formula, with the addition of sliced onion, proved to be 300 per cent more attractive than the unmodified bait of dilute molasses. Fresh onion ranked second, while plain dilute molasses ranked third. Of the other baits, stale beer attracted a large number of these flies as well as many others.

To determine the toxicity of the baits, check traps were included in the above experiment. Comparison of the mortality of the flies in these traps with the mortality in traps containing the same bait with sodium arsenite added, showed that from 11 to 50 per cent mortality was traceable to the poison. The general average was very low, not over 15 per cent. This would indicate that large numbers of flies are attracted to the baits but do not feed. Of course most of the flies which visited the baits entered the traps, whether they fed or not.

Collections of flies before and 2 hours after the application of the spray, on June 23, showed 20 per cent mortality due to spraying, 53 hours later.

Ten experiments were performed in the laboratory to determine if the sodium arsenite was effective at the rate used. From 12 to 56 flies were used in single experiments, and feeding was observed in almost every case. The general conclusions of all the experiments were that sodium arsenite at 5 grams to the gallon is fatal to the onion fly, the cabbage fly, and the fringed Anthomyian. The poison took visible effect in 5 to 8 hours, and was fatal in this length of time to 37 per cent (checks run in each experiment). It proved fatal in from 20 to 22 hours to 50 to 100 per cent of the flies. In several of the experiments, flies reared from onions were used. Plain molasses, which was usually fed the flies in the check, is a very suitable food. Adults have been kept living on this diet for as long as 36 days.

Reasons for Failure of Poisoned Bait in Field

Judging from the experiments mentioned above, the failure of the poisoned bait in practice may be due to one of several causes, or combinations of them. It is certain that the flies do feed on on the bait with fatal results. However, other sources of sustenance may be more attractive in nature. On the other hand, flies have been observed to feed on the bait in the field. The results of the fly trap experiments rather indicate that large numbers do not feed after visiting the bait. The most important factor has not yet been mentioned, namely, climatic conditions. In Wisconsin, the critical period in the control of the onion fly is invariably rainy. Rains not only interfered with the regular application of the spray, but in many instances washed the bait away before the flies had time to feed on it.

Investigations for Year 1916

In 1916, therefore, the bait was given a trial in the same locality, but pie tins were used to hold the liquid, and the bait was modified by the addition of a sliced onion to each pan. Eight-inch pie tins were placed at the rate of 40 or more to the acre as soon as the onion appeared through the soil (Pl. 3, fig. 2). Seven acres on one farm were thus treated, and almost as many acres on four neighboring farms. On portions of the seven acres 60 "Harper" fly traps were used, and 40 extra large fly traps constructed for the purpose (Pl. 4, fig. 1).

The pans and traps were replenished as soon after showers as possible, but the weather was extremely wet, even more so than in 1915. The experiment was started May 12 and discontinued June 25. The season was late, and when the writer was transferred to Madison on June 1, no eggs had appeared in the field or in the cages. The experiment was continued under the personal supervision of the grower, who attended to it very carefully. During June the maggots appeared in enormous numbers.

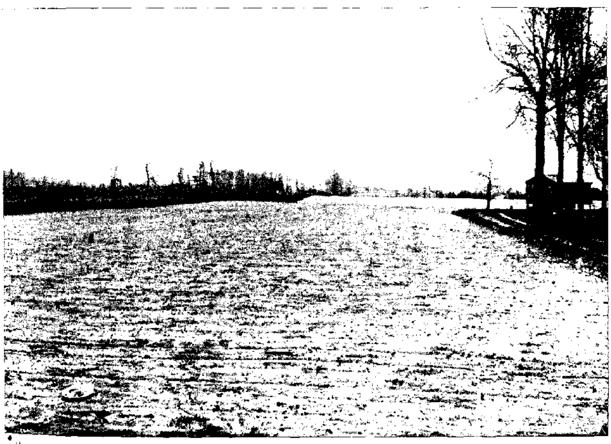
On July 3 the writer visited the fields and found that many of them had been plowed up, the devastation was so complete. The few fields which remained intact showed injury conservatively estimated, after consultation with growers, ranging from 95 to 45 per cent. Plate 4, figure 2, photographed in August, shows one of the fields injured to the extent of 75 per cent.

Conclusions

For two seasons the poisoned bait for the onion fly has given decidedly negative results.

Failure was due, to a great degree, at least, to adverse climatic conditions. These conditions are normal to this section of the country, however, and to other onion growing districts, I understand.

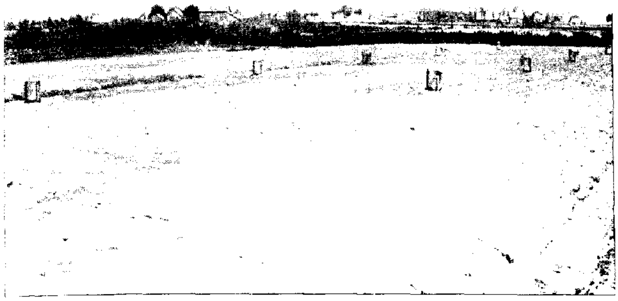
1

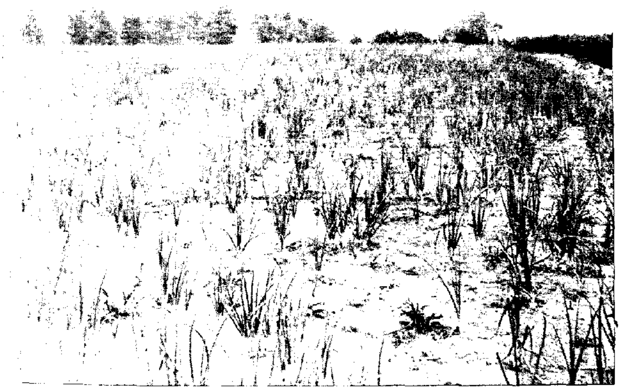


2

1. Method of applying poison bait for onion fly practiced in 1915. Original

2. Method of applying poison bait for onion fly in 1916. 100 pie tins and 53 small fly traps on three-acre field. Original





1. 10 large fly traps on one-quarter acre field of onions. Original

2. Portion of three-acre field shown in Fig. 2 (Plate 3), photographed in August. This field was injured to the extent of 75%. The area in the foreground shows a higher percentage. Original

In sections where the onion fly occurs and where climatic conditions are more favorable to poisoned bait applications, further trial is strongly recommended.

PRESIDENT R. A. COOLEY: We are grateful for this contribution to a perplexing problem. Do you wish to ask questions or discuss this paper?

MR. T. J. HEADLEE: I am under the impression that the investigator didn't have very good success. We have had two years' experience with it on the Sanders' plan and we have had a good deal of success. We are very enthusiastic about it.

MR. N. F. HOWARD: I would like to ask Dr. Headlee if climatic conditions in New Jersey, where the experiment was tried, were similar to those in Wisconsin which I described.

MR. T. J. HEADLEE: We had some rain, about fifty inches during the year; but I can't say we had continuous rain.

MR. N. F. HOWARD: I should like to ask in what way the results were checked, how far from the fields were they treated, and what evidence there was that less injury on the field was not due to different conditions. In our experiments we found that we had to use great care in choosing a check. We have found the flies in the center of Green Bay, a mile and a half from onion fields, and in cruising out on Green Bay we found them on the side of the boat. Whether they were there at the time we left town or not, we don't know.

MR. T. J. HEADLEE: This work was done as more of a demonstration and there were no plants immediately adjacent to the field, but there were several growing sections, and the treated areas, while pretty well removed, were perhaps within half a mile and outside of that area there were numerous fields with serious injury. There was no effort to carry on an experimental test. Where the treatments were applied, we didn't have any trouble: where the treatments were not, we did.

MR. N. F. HOWARD: Several growers in the district where I worked in 1915 and 1916 recommended very strongly this method after trials in 1914; but the onion maggot infestation in Wisconsin in 1914 was very light and in 1915 it was very heavy and no benefits were gained from the application. In 1916 the infestation was still heavier and we noticed no results at all as a result of the application of this method.

MR. J. G. SANDERS: It must be remembered that our first test of this method of destroying the onion maggot was at Racine, where we had a rather dry, early growing season. Now Racine, Wis., is only a few miles above Chicago and the conditions there for testing this material were almost ideal. When I asked Mr. Howard to carry on

his tests further the next year, I purposely wished him to go into that portion of the state where we could test this material under the most adverse conditions. In Green Bay, Wis., about half-way up the western side of Lake Michigan, we usually have very wet, rainy seasons. 1915 and 1916 were unsually wet; in fact, it rained almost every day for several weeks, and I think that had a great deal to do with the failure of the application of this bait.

Dr. Headlee's report on their success under New Jersey conditions appeals to me as warranting further tests of this poisoned bait spray under reasonably satisfactory conditions.

I don't know of any other control for this terrible pest, because any of you who have been in the onion-growing districts and have seen such conditions as have been portrayed here realize what this means to an onion grower.

Mr. J. S. Houser: During the years 1915 and 1916 we attempted the use of this bait in the muck land of northern Ohio. There the weather conditions were apparently much the same as those conditions which prevailed in Green Bay, because in both seasons we had very rainy weather at the time of application and at the end of the growing season we felt that very little good had been accomplished by the application. During those two seasons the cost of the application far exceeded the value of the crops. However, we are not absolutely discouraged with the method and since it does afford some promise, we hope to repeat it in a much more thorough way and on a larger scale in the years to come.

Mr. F. Z. Hartzell: In regard to fighting of onion maggot, it is sometimes unsuccessful because of the drying of the material before the flies eat sufficient of it, and I think the plan that has just been outlined, of using pans on the onion bed, would overcome that difficulty. I think that would help at least in the dry seasons. I do not recall how Professor Headlee applied his material. I would like to ask that question.

Mr. T. J. Headlee: We applied the material by the Sanders' method, whisking it directly on the plant with a whisk-broom.

Mr. J. G. Sanders: I would suggest that any of those who are contemplating testing out this material should remember to apply this poisoned bait spray to adjacent vegetation as well as to the onion field. I think that is really more important than making the application in the fields until the onions are of fair size.

President R. A. Cooley: This investigation and discussion seems to me to be almost typical of rather a broad condition. We might be led to be discouraged and not continue these studies which now appear to be somewhat conflicting, and that in the face of the fact that this

insect is doing a great deal of damage. I believe that in many cases in the past in such investigations we have discontinued the work just at the time when we should have continued it. That is almost a typical example of what I just mentioned.

There appears next on the program, "Notes on the Biology of the Angoumois Grain Moth," by Mr. King, of Harrisburg, Pa.

NOTES ON THE BIOLOGY OF THE ANGOUMOIS GRAIN MOTH, SITOTROGA CEREALELLA OLIV.

By J. L. KING,[1] *Scientific Assistant, Bureau of Economic Zoölogy, Harrisburg, Pa.*

In recent years the southeastern wheat producing counties of Pennsylvania have suffered an aggregate annual loss of over a million dollars through the yearly pillage of the wheat crop by the Angoumois grain moth (Fig. 5). Most of this loss occurs after harvest, and is due to the common practice in this region of storing unthreshed grain in the barns until some convenient time for threshing, then too, it is interesting to note that the Angoumois grain moth does *not* confine its depredations entirely to stored grain, as hitherto considered, but may begin its attack on the developing grain in the field, as is shown in the following study of the life-history.

LIFE-HISTORY OF THE ANGOUMOIS GRAIN MOTH

On May 1, 1917, a field station was located at York in York County, Pa., for this study. Observations started immediately in a series of field investigations, and inspections of straw stacks, barns, granaries, mills and warehouses.

HIBERNATING LARVÆ.—In the fields no evidence of hibernating larvæ could be found, nor did surrounding conditions appear favorable for them. On the other hand, mills and warehouses contained much infested wheat, but these were generally confined to the towns and cities. On the farms in the infested districts little or no wheat remained. However, in practically all the supposedly empty barns infested grain was found lodged in the cracks and crevices of the mow floor, on the beams above the mow, or under straw piles: and not infrequently hay, which had been partly covered by the sheaves of wheat, contained infested grain which had been shaken from the heads. In a number of instances large bags of mill screening were found to be literally "pure cultures" of living Angoumois larvæ.

[1]The writer takes pleasure in expressing his appreciation of the kind suggestions of Prof. J. G. Sanders, under whose direction these studies were conducted.

The larvæ pass the winter within this scattered grain in various stages of development between the half-grown and mature larval stages. In the early spring the immature larvæ again start to feed and complete their growth; the fully grown larvæ remain quiescent until shortly before the pupation period.

THE COCOON.—During the middle and latter half of May the larvæ start to spin their delicate silken cocoons within the wheat grains. The space thus occupied by the cocoon is cleared of all frass particles, this generally being packed to one side of the hollow grain, or sometimes it is cast out of the grain through a small hole which is gnawed through the side. Further preparation for final exit is made by gnawing almost through the distal end of the grain (the end opposite the plumule), leaving only a very thin circular membrane. The cocoon proper is thin and delicate, consisting of but a single layer of fine white silk which covers the walls of the cavity. After spinning the cocoon the larvæ remain quiescent for two to three days before pupation occurs.

PUPATION.—At York, Pa., pupæ were found as early as May 10, but were not abundant until after May 20.

The duration of the pupal period as observed at York during late May and early June varied from ten to seventeen days, having an average of thirteen days. When first formed the pupæ are light honey yellow, but soon turn to a golden brown as they harden. Before the final ecdysis takes place the developing moth is easily seen through the transparent pupal sheath.

EMERGENCE AND HABITS OF THE MOTHS.—The moths emerged throughout the day, but seemingly a larger per cent leave their cocoons during the morning. Escape from the cocoon is made by pushing against the thin exit membrane, which parts at the margin, and lifts as a hinged lid. The expansion of the wings is accomplished in fifteen to twenty minutes, and feeble flight is possible within an hour after emergence, but as a rule flight does not take place for several hours.

The moths are crepuscular in habit, being most active in the dusk of early evening and morning. At these times they may be observed mating and depositing their eggs.

The moths which develop from the hibernating larvæ constitute the first brood, or spring generation, which causes the initial larval damage to the season's wheat crop. This brood appears toward the end of May, and seems to reach its maximum numbers between June 5 and 15. After June 20, moths are not common.

OVIPOSITION.—As the period of oviposition is indicated by the period of the moth flight, it is worthy of note that this is also coincident with the heading of the wheat in the fields. In York, Pa., and the

surrounding country much of the wheat is in head as early as June 1, but bloom does not follow until about the 4th, continuing over varied conditions until about the 15th. However, most of the grain is well set before this latter date.

At this time a large series of experiments were conducted to determine if the adults would oviposit on green wheat, and what stages in the growth of the grain would be necessary for the sustenance and development of the newly hatched larvæ; also, to determine if oviposition naturally occurred in the field upon the green heads. Single female moths, accompanied with two or three males, were confined in small tarlatan bags, and placed over the heads of growing wheat, which was in varying stages of growth—from pre-bloom to well-set, milky grain.

In all but three cases out of forty the moths so confined deposited their eggs upon the heads of green wheat. The eggs were commonly found carefully inserted under the protecting outer and empty glumes; also, along the edge of the glumes covering the seed. However, this placement of the eggs is not unerring, as eggs are sometimes placed between the spikelets and the main stalk.

The eggs are sometimes deposited singly, but clusters of four to sixteen are not uncommon. The total number of fertile eggs per individual ranged from thirty-six to one hundred and forty-six. The average total egg production in the case of four moths under observation was ninety-two, in which case 44 per cent were deposited the first day (24 hours) after mating, and 19 per cent the second day. Later egg production decreased suddenly, falling to 3 per cent on the fourth day. Under the warm temperature of mid June, the egg stage lasts from seven to nine days. Moths in tarlatan bags in the field lived three to eight days, having an average longevity of five and two-fifths days, whereas those protected from the rigors of the weather lived an average of seven days.

Habits of the First Stage Larvæ.—Wheat in all stages of development, from the incipient seed before pollination to the green grain, in the milk is subject to the attacks of the larvæ. However, in nature few larvæ appear early enough to attack the heads before pollination.

The larvæ after leaving the eggs immediately distribute themselves over the head on which the eggs had been deposited, and almost invariably but a single larva enters each grain. The larvæ enter the grain by gnawing through the soft pericarp, either near the proximal or distal end of the grain, or through the longitudinal furrow. At first larval growth seems slow, and only slightly impedes the growth of the grain, but ultimately, as the larvæ become mature, the entire wheat grain is hollowed out.

Length of Life Cycle.—Larvæ which entered wheat while in

bloom June 13 began to emerge as adults on July 23, continuing to July 31; thus requiring from forty-one to forty-nine days from hatching of larvæ to emergence of the moths. Likewise, larvæ that entered green and milky wheat required from forty to fifty-four days to complete their development.

Inasmuch as the Angoumois grain moth has been considered an economic pest of stored grain, it seems worthy of note that the foregoing observations on oviposition and development of larvæ within unripe grain were also verified by coinciding field observations. Eggs and young larvæ were found in the growing grain during early June, and adults began to emerge in late July from the harvested grain,

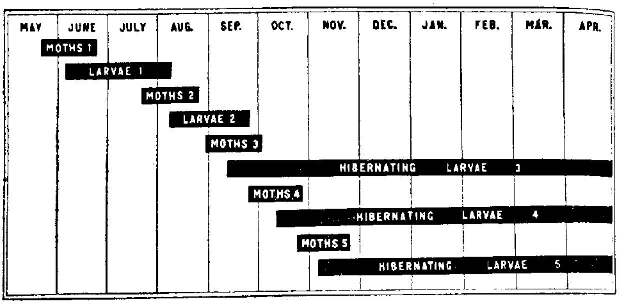


Fig. 4. Diagram of broods of Angoumois grain moth. Moths 1, first brood from overwintering larvæ in barns and granaries; Larvæ 1, larvæ in developing grain; Moths 2, second brood at harvest time; Larvæ 2, second brood larvæ occurring in field or stored grain; Moths 3, third brood in stored grain, and in part in waste grain in field; Hibernating larvæ 3, part transforms to fourth brood—remainder hibernate; Moths 4, fourth brood; Hibernating larvæ 4,—part forms fifth brood—remainder hibernate; Moths 5, fifth brood; Hibernating larvæ 5, fifth brood larvæ all hibernate.

coincident with moths reared in the experiment plots. This initial field infestation is sparse and scattered, thus accounting for the very general distribution of later broods.

Number of Generations.—The moths appearing at harvest time constitute the second generation, which occurs approximately between July 20 and August 14, with its maximum numbers during August 1 to 6. In case of late gathering-in of the harvest a small part of this brood emerge as moths in the fields, which in turn gives rise to a third brood during September 1 to September 20. This third brood is the final brood occurring in the field. On the other hand, the moths of the second generation, which emerge in the warm tight barns, carry on their depredations through as many as six, and possibly seven, genera-

tions—providing the grain remains unthreshed in the mow and severe cold weather is delayed.

Farm Practice Favorable for the Moth

A common farm practice in the region under consideration is to store the unthreshed wheat in the mow until some future time when threshing is convenient, or to thresh the grain only as there is need for the straw. This method of storing grain in the exceptionally tight and well-built barns, which are characteristic of this region inhabited by Pennsylvania Dutch, is conducive to a most rapid development of the moths. During the month of August, wheat in the mow of one of these

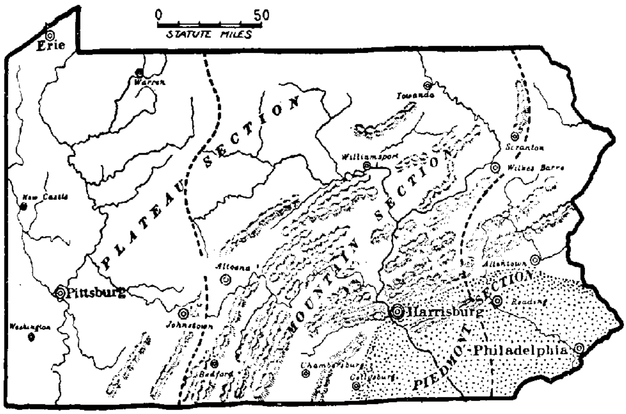


Fig. 5. Map of Pennsylvania with shaded area showing region of severe Angoumois infestation.

infested barns retained an almost constant temperature of eighty to eighty-five degrees F., and during September a temperature of seventy to seventy-five degrees F. This so stimulated growth that by the end of October as many as five generations had been reared (Fig. 4).

Control Measures

The greatest step in the control of this pest will be accomplished as soon as the Pennsylvania farmers see the fallacy of storing unthreshed grain for long periods in the mow, and will thresh as soon after harvest as possible. Grain stored in tight granaries, or in good sacks, is less liable to repeated attacks of the moth, and may be easily treated with carbon bisulphid. Further, attention to thorough barn sanitation, by the elimination or complete utilization of all scattered wheat, is of

extreme importance in checking this pest. Thorough sweeping of the mow floor and beams is necessary. Poultry enclosed in the barn will also aid in cleaning the grain from the cracks and crevices of the floor. Infested screenings if kept in the barn should be ground, or immediately used as feed, and in the future all grain should be threshed in the open to avoid reinfestation of the barn.

Finally, all sanitary work should be of a coöperative nature throughout an infested district, in order to insure against reinfestation from a negligent neighbor. Under the present conditions it is not advisable to do away with carbon bisulphid fumigation, but the writer is of the opinion, that in the future if coöperative early threshing and thorough barn sanitation are practiced, the use of carbon bisulphid will not be necessary.

PRESIDENT R. A. COOLEY: Do you wish to discuss the paper by Mr. King on this grain pest?

MR. J. G. SANDERS: These five counties in southeastern Pennsylvania produced probably one third of the entire wheat output of the state. I think the latest figures are approximately 13,000,000 bushels. The loss in some sections last year and the year before ran as high as 75 to 90 per cent of the crop in some limited areas.

I do not think Mr. King brought out very vividly or strongly the reason why this pest seems to cause such great destruction in this area: because in this area the farmers have that unfortunate habit of storing their cut or harvested grain in the mows and then threshing it out during the winter as they need the straw, or as occasion affords. The problem of saving anywhere from one to two or three million bushels of wheat at this time is extremely important, and if we can secure the coöperation of farmers in that section of the state next spring to carry on sanitation measures in cleaning up the old hang-over wheat in every conceivable place and position, I think we would be accomplishing a very desirable result.

Ultimately, I think that the pest can be held in control by sanitation measures, without resorting to fumigation with carbon bisulfid. That is only ameliorating the condition at best; but if we can secure the coöperation of the farmers and if they will change their habits of farming, I think this pest will disappear. It is one of the most serious pests, as we now realize.

MR. M. H. SWENK: I am interested in this because during the past summer for the first time we found this insect working in the wheat fields in Nebraska. I want to ask Mr. King definitely if he has any indications in his studies of the life-history, that it is possible for the angoumois grain moth to persist in the field throughout the year, or must it always emanate from granaries individually?

MR. J. L. KING: This study has only been conducted since the first of May. I have found larvæ hibernating in the field. I am studying them under various conditions and I have also planted infested grain, through which there seems to be some possibility that they might be carried into the soil. At first I didn't think it was at all possible, but I was greatly surprised on planting infested grain to have a few moths work their way up through the soil and they could fly away. Whether larvæ can go through the winter, I am unable to state as yet.

MR. G. A. DEAN: For at least ten years the grain moth has been one of the most serious pests we have had in Kansas in several different grains. It was first very serious in wheat, laying its eggs in the chaff and also in the stem. Now they are not causing much trouble to the wheat because the farmers thresh as soon as they can after harvesting; but it has gone into the chaff. The grain moth in Kansas is the most serious pest we have in those seeds, when stored. Our farmers must fumigate these seeds with carbon bisulfid before they are sowed. If they don't they will lose from 50 to 75 per cent of them. Our seed men had that sad experience with the angoumois moth.

PRESIDENT R. A. COOLEY: The meeting will now stand adjourned.

Adjournment.

Morning Session, Tuesday, January 1, 1918, 10.00 a. m.

PRESIDENT R. A. COOLEY: The first paper on the program is by E. P. Felt on "Insects and Camp Sanitation."

INSECTS AND CAMP SANITATION

By E. P. FELT, *State Entomologist of New York*

The battlefields of Europe are now the assembly grounds for the human race. Some of almost all nationalities and huge numbers of a few have met in a struggle of world-wide significance. They have brought with them their blood parasites and infections and all too frequently carriers of disease. We know that lice and typhus, flies and cholera, typhoid and dysentery, fleas and bubonic plague, mosquitoes and malaria, are to be found among the troops of the battle-scarred regions.

Here is a biological complex or association unparalleled in the history of the world and the complexity is still increasing. The dispersion at Babel is being followed by the assembly at Armageddon. Other nations are entering the conflict and at present many thousands and soon millions of American citizens may be directly involved in this gigantic struggle. We are more deeply concerned with these last, though it should not be forgotten that our future is closely linked with that of our

Allies and, moreover, that undue prevalence of disease among the enemy may, though giving us temporary advantage, ultimately react to our hurt. It should be remembered that while the problems of the war may be most urgent and vital, those that follow may be even more serious in their effects on the human race. Earlier conflicts have been followed by epidemics of disease, some extremely disastrous, and there is no reason for believing that the same will not obtain in at least some measure as an outcome of this struggle.

Susceptibility to disease is a most important factor and it is to be feared that in this respect American troops will be at a disadvantage, as compared, at least, with certain other combatants, owing to the fact that our higher standards of living have in a measure reduced resistance to disease, though this may be offset to some extent by preventive inoculations.

The importance of disease control under army conditions is not generally appreciated, though it is a well-known fact that in the Spanish War, a disturbance accompanied by very little fighting on the part of Americans, deaths from disease greatly exceeded those from wounds. The total number of deaths among the British non-commissioned officers and men in the Crimean War from April, 1854 to June, 1856 was 18,058, including all who died in the field or in the hospital from wounds and disease. Deducting 1,761 deaths from wounds, we have 16,297 deaths from disease.[1] In the South African War, 1899 to 1902, 6,965 died from wounds, as compared with at least 13,590 from disease, while 72,551 sick were invalided back to England. It is significant to note that for every man admitted to a hospital on account of wounds, 17 were admitted because of disease.[2] In 1869 there were 972 deaths from cholera among the British soldiers in India, while in 1912, with a much larger number, there were only 14.[3] The importance of affections of the digestive tract is shown by the fact that the chief epidemic diseases of the Mediterranean Expeditionary Force were enteric (typhoid) fever and dysentery. During the last six months of 1915 there were admitted in General Hospital 21 on the medical side 5,300 cases, 1,723 being classed as enteric and 1,146 as dysentery; thus more than half the medical cases came in one of these two classes.[4] Cholera was quite prevalent in Austria-Hungary, especially Galicia, from September 27, 1914 to September 18, 1915, there being 27,591 cases with 15,270 deaths.[5]

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[1] 1917. Garrison, F. H. Military Surgeon, 41: 469–470.
[2] 1917. Copeman, S. M. Journal of State Medicine, 25: 105.
[3] 1917. Goodwin, T. H. Military Surgeon, 41: 386.
[4] 1917. Bartlett, G. B. Quarterly Journal of Medicine, 10: 186.
[5] 1917. Ford, J. H. Military Surgeon, 41: 7.

The above figures give an idea of the great importance of disease from a military standpoint. It will be noted that the number of deaths in hospitals from disease exceeds and in certain cases greatly exceeds, the number of deaths from wounds. This by no means tells the whole story, since in Serbia during the winter of 1914–1915 there was a general outbreak of typhus, one in every five of the population developing the disease and 135,000 (including 30,000 Austrian prisoners) dying. The mortality ranged as high as 65 per cent though in some hospitals it was as low as 19 per cent.[1]

The results possible from the application of preventive measures is indicated by the following: During the first winter of the Crimean War the British had 2,286 deaths from fever and 129 in the second. They lost 164 men from typhus the first winter and but 16 the second. There were 3,196 deaths of British soldiers during the first winter from diarrhœal disorders and only 37 in the second winter.[2] During the first twelve months of the present war the average monthly mortality rate for disease was, in round numbers, 29 per thousand and for the succeeding eight months 14 per thousand, while for wounds the rate was 34 per thousand for the first year and 15 per thousand for the first eight months of the second year.[3]

The foregoing data has been restricted by design largely to diseases which are carried in part or entirely by the agency of insects, since this paper is primarily entomological. In not a few instances the control of disease is determined by the solution of the insect problem and this is notably true of typhus and lice, bubonic plague and fleas and mosquitoes, yellow fever and malaria. The intimate relation between insects and disease is less evident though very real in the case of flies and such affections as cholera, typhoid, dysentery and probably tuberculosis. We know that insects may be carriers of all these diseases and it has become evident within the last few months that the hardships and privations of war have been followed by numerous cases of tuberculosis and it is reasonable to expect, even if there be no epidemic, that other preventable diseases will exact a heavy toll among the unfortunate populations of the stricken areas. The situation, in our estimation, justifies the ranking of the insect menace as one of the important problems in the conduct of the war, second only to the equipment and provisioning of the army and the adequate care of the sick and wounded. In fact, insect control is intimately connected with the last. Not only is there urgent need of looking after this phase of sanitation but the probabilities are, as the war progresses, that the medical

[1] 1916. Beasley, S. O. Military Surgeon, 39: 634.
[2] 1917. Garrison, F. H. Military Surgeon, 41: 469–470.
[3] 1917. Military Surgeon, 40: 100.

and sanitary staffs will be so overwhelmed with the care and protection of the seriously stricken, that matters of apparently minor importance, such as the control of insect pests, must of necessity be neglected to some extent. As indicating probabilities along this line a note credited to Lord Northcliffe is worthy of reproduction: "It is well known now that in spite of the almost universal efficiency which characterized German preparation for the war, the German medical force dropped down entirely and was unable to meet the terrific casualties."[1] Both knowledge and reason indicate that prevention is far more effective than cure. Here is where the entomologist should step in and relieve the physician and sanitarian by discharging a duty for which he is particularly qualified. It is gratifying to note in this connection that in the "British Army every expeditionary sanitation unit of seventy men, rank and file, now includes two trained entomologists."[2] American efficiency may accomplish much, though it is hardly believable that in a few short months we can handle matters as satisfactorily in all details as a nation which has spent years in preparing for just such eventualities and for that reason, if for no other, we should take advantage of every supplemental agency.

Insect control under field and camp conditions presents many problems which cannot be foreseen. It can be handled best only by those who have had extensive experience with insects and are therefore in the position of experts so far as determining what methods should be adopted for either normal or emergency conditions. It is well known that work under the guidance of men who appreciate the possibilities is likely to be vastly more successful than that supervised by those unacquainted through experience with the problems they are expected to handle. Every economic entomologist has been the recipient of hundreds of accounts of failure to control insects, and in practically every case this has been due to not grasping the essentials though an honest endeavor may have been made to carry out directions. We submit that in cases where human life, in many instances thousands of lives are imperiled, the best is none too good and, if there be failure, the employment of experts would presuppose that every reasonable precaution had been adopted.

The work should be organized on a unit basis and a competent entomologist attached to every large military unit and accorded a ranking which will insure respect for his recommendations. There would naturally be several main lines of effort, viz.:

1. Protection against disease carriers. This would resolve itself first into the elimination, so far as practical, of opportunities for insects

[1] 1917. Military Surgeon, 4: 31.

[2] 1917. Calvert, P. P. Old Penn, 15: 302.

to become infected, a phase which largely devolves upon the physician, though the entomologist might render conspicuous service. It would fall to the latter to see that every reasonable precaution was adopted, to reduce the breeding of insects to a minimum and to check their dissemination so far as possible. The last is of special importance with body parasites.

2. The protection of food, though vastly less important than the preceding, should receive attention, since by the adoption of comparatively simple precautions in handling and storage it would be possible to avoid waste and serious loss. Inspection by an entomologist would in most cases determine the probable source of infestation and go far toward fixing responsibility.

3. Protection of domestic animals. A general survey of camp surroundings would indicate at once the more prolific breeding places for mosquitoes, especially malarial carriers, and would incidentally disclose the localities most likely to be infested by horse flies and similar troublesome pests. The location of the camp and the disposition of camp refuse, including the manure from animals, must be determined largely by local conditions and apparently unimportant modifications may have a material effect upon the abundance of insects and the annoyance and danger resulting therefrom.

It is not expected that a flyless and insectless camp can be maintained, especially under field conditions, but it is practical, by the adoption of systematic measures, to largely reduce the insect menace, not only by the prevention of breeding but by the adoption of special means of protection wherever there is an opportunity for the dissemination of disease. The autocratic military type of organization is admirably adapted to the carrying out of such work. This latter, as has been pointed out earlier, is of particular importance in the case of American troops because they are presumably more susceptible to certain infections than men who have lived for years under less sanitary conditions.

With the above in mind, we hold that the entomologist, particularly the economic entomologist, is in a position to render invaluable service in protecting the health of our troops and that, furthermore, the efficiency of the sanitary and medical corps of the army will be greatly increased by the coöperation of such experts, since their special knowledge would permit the quick solution of many difficult problems and at the same time relieve our medical men for their very necessary and frequently more urgent duties.

There is another phase of the problem which should ever be kept in mind and that is conditions likely to obtain after the war. Almost every great war has been followed by widespread, frequently very

deadly epidemics, not only in sections directly affected but also in other parts of the world, especially those to which combatants returned. The world-wide character of this conflict makes the latter phase of great importance to all nations, since the removal of military restrictions, unless there be a rigid sanitary supervision, would give unexampled opportunities for carriers of deadly infections to make their way into other countries and spread disease. This applies to insect borne infections as well as to other maladies. Only the most thorough precautions can prevent extensive outbreaks and certain safeguards are not possible unless there is an intimate and general knowledge of the habits of insects serving as carriers.

The heavy hand of poverty is destined to rest upon extensive areas of the earth and with that may be expected a lowering of sanitary standards and a consequent increase in disease. It is most important that this latter be prevented so far as possible so that post-war conditions may not be worse than those at present obtaining. This can be accomplished by the adoption of the most effective methods for the control of disease and here the entomologist is in position to render an exceedingly valuable service not only to his country but to the entire world.

The vital importance of the effective control of disease is indicated by the following excerpts from the introduction to "Epidemics Resulting from Wars."[1]

An examination of the facts presented in the monograph "indicates that until comparatively recent times the most serious human cost of war has been not losses in the field, nor even the losses from disease in the armies, but the losses from epidemics disseminated among the civil populations. It was the war epidemics and their sequelæ, rather than direct military losses, that accounted for the deep prostration of Germany after the Thirty Years' War. Such epidemics were also the gravest consequence of the Napoleonic Wars. . . . One can point to the fact that in the present great war, the only serious epidemic that has been reported is the typhus fever epidemic in Serbia. When the medical history of the war comes to be written, however, it will be found that the aggregate losses from sporadic outbreaks of war epidemics have been very considerable. A war sufficiently protracted to lead to universal impoverishment and a breakdown of medical organization would be attended, as in earlier times, by the whole series of devastating war epidemics. And even in the case of less exhausting wars, the chances of widespread epidemics are far from negligible."

[1] Epidemics Resulting from Wars, by Dr. Friedrich Prinzing, published by the Carnegie Endowment for International Peace, Division of Economics and History, John Bates Clark, Director, p. VIII–IX, 1916.

Large portions of the world are already in the condition described in the last sentence and considerable areas have suffered so greatly that general impoverishment is almost unavoidable and as the war continues larger areas, possibly territories inhabited by several nations, will be reduced to this pitiable condition.

SUMMARY.—Diseases are responsible for more deaths in armies during war time than are caused by wounds.

Insects are known carriers of some of the most deadly infections of the soldier and the only known means of dissemination for certain of these diseases.

Available data appear to justify the opinion that over one half of all the deaths in armies due to disease are caused by infections easily and frequently carried by insects, and some only through insect agencies.

Preventive inoculation has largely eliminated the danger from typhoid fever, though it is of no value against the nearly equally deadly dysentery. The insect menace is therefore, judged from both a military and economic standpoint, most serious and its reduction to the lowest possible terms is abundantly justified. This is not only important during war time but doubly necessary at and just after the conclusion of peace.

The military history of the world abounds with appalling examples of disaster following the appearance and rapid spread of insect-borne epidemics, one such already being known in connection with the present conflict.

The experience of our adversaries in this struggle has demonstrated that there cannot be too great preparation along medical and sanitary lines, while our allies have been forced by developments to make use of available entomological talent.

It is well known that camp conditions are favorable to the development of insects and, moreover, that these pests may thrive under very diverse conditions and gain access to deadly infections in most unexpected places.

The satisfactory control of such pests requires expert knowledge based upon arduous training and extensive experience and consequently we believe that the entomologist, the man with practical experience in the control of insect outbreaks, is in position to render invaluable service in protecting the health of our troops and at the same time relieving to a certain extent members of the sanitary and medical corps for their very important and frequently most pressing duties.

PRESIDENT R. A. COOLEY: We have had presented to us a very valuable contribution on this important subject. I will now ask you to discuss this paper.

Mr. J. L. King: I think every entomologist is especially interested in the present war and is willing to give his service in any branch which will be of aid to his country. After arriving in Pennsylvania, I found that the young men in the house where I was staying had enlisted in various branches of the military service which were along the lines of their particular training, and I therefore decided to make application. I wrote to Dr. Howard in order to find out whether there was any opportunity for service in the army along entomological lines. As there did not appear to be any openings, I made application in the sanitary service, but was informed that there were no openings there. What I would like to ask is, How are the services of the entomologists to be utilized in connection with camp sanitation? It seems almost impossible to enter the service at the present time.

Mr. E. D. Ball: I would like to ask Dr. Felt whether there has been any movement made in this direction.

Mr. E. P. Felt: At the time when it began to be apparent that the United States might be involved in the war, the speaker wrote one or two editorials in favor of having an entomologist attached to every large army unit and he is still of the opinion that such is highly advisable. It may be true that our economic entomologists are largely trained in handling agricultural insects, but I think every man who has had any experience whatsoever on insect work would be willing to back such a man against one who has not had such experience. That is his life work and with his intimate knowledge of insects, he is placed in a far better position than anyone else to forecast possibilities, to see the danger points and to adapt treatment to the conditions. I am of the opinion that there must be a great amount of this kind of work done in army camps before we get the most satisfactory solution of the insect problem. Work of this kind must be taken up in advance of pressing needs or disaster may result. We must not wait, as many farmers have done, until the crop is nearly destroyed, before taking action. Life is too valuable, the stake too large to warrant this.

Mr. E. D. Ball: Dr. Felt's position is conservative. The man who has had actual field work in handling any insect pest is much better prepared to immediately take up the field end of the problem of insect control than any man approaching it from the medical, sanitation or engineering standpoint. The latter may be perfectly trained in their professions, but their knowledge of insects and their behavior is very limited. The great function of the entomologist should be to size up the situation in the field and devise suitable remedies to meet each condition that arises. The secret of the success of the American entomologist has been that he is resourceful in dealing with the problems that are placed before him.

Mr. George A. Dean: The thing that surprises me most is the fact that so few of the medical men, bacteriologists, and sanitary engineers appreciate or even recognize that the entomologists can assist in solving these health problems. As Professor Lefroy of London, who visited my department only a few weeks ago, says, it is too bad, indeed, that we have to have terrible calamities come before we wake up and take notice. He says that at the present time there is Asiatic cholera and typhus right in the localities where many of our soldiers will be sent in France, and unless we are alive to the situation and expert entomologists are in the field, we are going to have the same sad experience that the English had in the first year of their campaign. Professor Lefroy was at loss to understand why this country, so well equipped with so many capable entomologists, was not using them in all of the army camps and units.

Secretary A. F. Burgess: I think we have had a very dangerous situation pointed out to us and that we appreciate that the situation *is* dangerous. We have also had pointed out that probably very little will be done until the situation becomes very serious indeed. I believe it is time for this Association to act. If we can do no more than go on record, we should do so, and point out what the situation is and that this Association and its members stand willing to assist in this great work. The difficulty of changing a system which already exists is very great, but unless all signs fail, the time is coming when it must be changed. It seems to me that the principle of the selective draft was to place men who were selected in positions for which they were best adapted. It is a pity that men who are trained along entomological lines and are needed should not be put on that important work. The time is coming when they will be, but I think the Association ought to consider this matter very carefully and take action at this meeting, pointing out the dangers that are ahead and placing its members at the service of the government.

Mr. Herbert Osborn: I feel very deeply on this subject and hesitate to express myself fully. I feel deeply because a great many young men have come to me and asked for advice. I could not tell them what to do. I knew that they were patriotic, and it seemed to me that they should serve their country where it would produce the greatest results for the government. Under existing agencies it is practically impossible for a man to go into the service as an entomologist. It is impossible for us to reorganize the agencies to bring about an order which would provide for entomologists as entomologists. I feel very strongly indeed that entomologists are American citizens. I think every one of our members in the United States wants to render the greatest service possible in this national emergency, and I think

we may come to a point where we must do this through existing agencies. I still have hope that it may come through the selective draft,—that men who put into their questionnaires a statement of their training will finally be assigned where they are best fitted to serve. I understand that certain groups of men have not been very cordially received because of their attempt to go into the army as a class. If the entomologists can get into the service, not as a class but as American citizens ready to go where they can be of the best service, they may ultimately be placed where they are able to do effective technical work. I do not wish to make any criticism that will give the idea that entomologists are not willing to serve their country in this time of need. We are going into this matter with the utmost loyalty and we are ready to serve in any capacity that is really necessary. But I do believe our committee on resolutions could draft a carefully worded statement that there seems to be need of special service and that we have a specially trained body of men that might be of great value. It does seem a pity that the man who is thoroughly trained in entomological work and able to distinguish a fly, mosquito or other pest that is dangerous from one that is harmless—possibly save great expense or suffering and loss of life by exercising this knowledge—should not be placed where his knowledge may be of greatest value. I have two boys in the army,—one in the medical service and another, who is a trained entomologist, is in the infantry. Neither of them is able to do anything entomologically except as he may be able to offer suggestions to associates or superior officers. We ought to be very careful about making criticisms that may be misinterpreted, but we should make it plain that we are ready to do our utmost and that we wish to point out, if possible, lines along which the entomologist can assist in supporting the government agencies from a technical, scientific and entomological standpoint. Above all we want to help win this war.

MR. E. P. FELT: I want to endorse most heartily what Professor Osborn has said. We are ready to give everything that we have and would like, if possible, to give along the most effective lines. If this Association, representing as it does the consensus of entomological opinion in the country, is willing to go on record as to the importance of this matter, I believe we will accomplish something. It isn't a question of preferment,—it is a question of rendering service. I believe that in our position as experts, we are justified in pointing out to those in charge of matters, the lines along which our men with their qualifications can work to the best advantage. That is what the government wants—to use the expert opinion of the country.

MR. S. J. HUNTER: There is another phase of this matter which has come to my attention through conferences with students who have

sought advice on this momentous subject. They will not go into this service that we all deem so important unless they can be made to feel in some official way that it is a real service that they are called upon to do for their country. I know of a number of cases of men who could have been assigned to entomological work but would not accept it as they preferred active military service, feeling that doing anything else was not fulfilling their entire patriotic duty to the country. It seems to me we ought to consider this matter.

Mr. T. J. Headlee: The War Department has commissioned two of our mosquito men as first lieutenants in the sanitary corp. One, Mr. Russell W. Gies, is now located at Camp Pike, Little Rock, Arkansas, and the other, Mr. Jesse B. Leslie, is stationed at Camp McClellan, Anniston, Alabama. They are engaged in mosquito work. I am convinced by a personal investigation of the situation at Washington, that the condition which prevents the utilization of the economic entomologist in the preservation of army health and comfort is a notion entertained by persons in charge of such matters, that he can contribute nothing worth while to that end. It appears to be the impression that the economic entomologist is a person interested primarily in the number of spots in the mosquito's wing or the number of spines upon the flea's foot and that his information is of a type that could not be put to practical use. Until this impression is removed and the true state of the case made clear, it is not to be expected that the economic entomologist will have a chance to do his professional bit in the army of the United States. The suggestion made by our Secretary is directly to the point. This Association should go on record in the form of a resolution or a set of resolutions in which the ability of the economic entomologist to perform a real service in connection with the military establishment will be set forth. Further than this, it should provide a medium through which its action may be made clearly understood by the persons in charge of army sanitation and health.

Mr. W. C. O'Kane: It seems to me that we are surely united on two or three propositions. Professor Osborn has properly said that the first of all is the matter of service. As an association and as individual members we surely propose to do that which will be of greatest value so far as we are permitted to do so, whether it be in the infantry or in entomological work. Second, I am sure that we agree with Dr. Felt that the situation in regard to camps and trenches is serious. Third, I am sure we agree that the trained entomologist can render very genuine service. I am not sure that we shall get very far by depending upon the various local boards of review. I wish I did think so, but each of these boards is, in a sense, on the defensive. There are many men coming to them who wish to do special work, and some of

these men wish to do it because they do not want to do something that might be more dangerous. That is not true of course of all men who go to them, but still it seems to me that the boards are on the defensive. Again there ought to be uniformity, so far as there is uniformity in the capabilities of entomologists. On the other hand, if we adopt resolutions here and print them in the JOURNAL, I do not know just how much weight it will have. What I am wondering is whether, if the matter were rightly presented to the War Department by two or three men representing this Association,—not as a question of exemption or of preferred classification, but as a question of maximum service—we might not get something out of it.

MR. F. C. BISHOP: I deeply appreciate the very careful analysis that Dr. Felt has given us of the situation. It certainly was a most admirable paper, and I also appreciate very heartily the comments of the various members of the Association and their effort to really put the entomologist in a position to do his greatest work in connection with the war situation. I have had a little personal experience in connection with the military camps, working largely in Texas where probably the greatest concentration of troops has been. I have come in contact more or less with the camps and regular army posts and have seen a little of the sanitary conditions. I can say that I fully agree with what Dr. Felt and others have said in regard to the need for the work of trained entomologists, and I also agree with the statements of Mr. O'Kane concerning the matter. At this time we must give very careful consideration to the interpretations that might be put upon an action of this sort, and this can best be done by a committee giving it very careful thought and then have the whole Association act following such a report.

PRESIDENT R. A. COOLEY: I have been impressed with the loyalty of the young men in the colleges who have come up for military service, many of whom, while preferring service in their own line, were willing to serve in any capacity. Some that I know have attempted to withstand public sentiment, thinking that they could perform more valuable service in their own line than to enter the army or the navy. Another point which might be mentioned in connection with army work is the need for entomologists in the service outside of medical entomology. I believe Professor Lefroy, who was recently in this country, is not a medical entomologist at all, but was here on his way to investigate the work of certain insects on stored grains. Entomologists are needed in the army for the preservation of food stores as well as in medical or preventive work.

We have in Montana a State Board of Entomology. This was created by law for the purpose of studying the control of insects that

transmit human and animal diseases. We have met with official barriers from the first in this work. I have no resentment in the matter at all and know just where the trouble is. It is merely because those high in authority do not see matters as we see them. I believe they think they are doing the very best they can, and I think it is highly desirable that there be a frank and full conference between representatives of this Association and certain men in Washington, and that very likely there will be no barrier between us at all.

Mr. F. C. Bishop: I will say for the information of those here that my understanding in the case of Dr. Jennings is that his commission in the Sanitary Corps of the army was given not because he was an entomologist, but because he was a good all around sanitarian.

Mr. W. H. Goodwin: The point made by the English entomologists concerning the preservation of food products is of vital importance. Most people have no conception of the quantity rendered unfit for food by insect infestation. Most of the material voided by insects injurious to cereals and cereal products is in the form of ureates of ammonia, and contains practically no moisture. When these are taken into the digestive system they immediately become soluble, and cause an excess of ureates which may act as toxic poisons, and in small amounts daily cause a complexity of derangements. This has been tested experimentally in a limited way by feeding cakes made from infested material to dogs, and obtaining symptoms of toxic poisoning. We can draw our own conclusions concerning insect-contaminated products used for human food and its effects.

Mr. C. L. Metcalf: I am a little more hopeful about the situation than some of the members who have spoken. One of my former students is in the Base Hospital at Philadelphia. He told me several weeks ago that he was pretty certain that his captain was going to utilize his services along insect lines. I am hopeful that our men going into service in the ordinary channels will be utilized by the War Department whether they are officially recognized as sanitary entomologists or not.

Mr. H. A. Gossard: I move that a special committee of three be appointed by the chair to consider a proper course of action and draft resolutions concerning this matter.

Secretary A. F. Burgess: I have a suggestion to make in this connection. At a good many of our meetings the committee on resolutions is rather an honorary job. It seems to me that if this matter were referred to them it would give them a chance to work to the limit. If the motion made has been seconded, I would like to offer an amendment that the matter be referred, in so far as resolutions are concerned, to the committee on resolutions.

Mr. H. A. Gossard: I am just now told that already some steps have been taken by the committee on resolutions to try to meet the situation, so I will withdraw my motion.

By a vote of the Association, the matter was referred to the committee on resolutions.

Mr. E. D. Ball: The committee on resolutions would request Professor Herbert Osborn and Dr. E. P. Felt to assist in the consideration of this matter and drawing of resolutions.

A motion was then made by the Secretary that a committee of three be appointed to bring any action which the Association might take through its committee on resolutions to the attention of the War Department or proper authorities in Washington. This matter was discussed freely by a number of members present, and after due consideration the Association voted that a committee of three be appointed by the President.

Adjournment.

Afternoon Session Tuesday, January 1, 1918, 1.30 p. m.

President R. A. Cooley: In view of the fact that none of the past presidents have arrived, I would suggest that the discussion of the subject "How Can the Entomologist Assist in Increasing Food Production?" be thrown open for discussion by the members.

Secretary A. F. Burgess: The state of Kansas has been doing a great deal of extension work, and at a good many of our meetings we have had reports from that state in connection with the successful work that has been done along that line. I don't like to embarrass any one, but I would like to ask Professor Dean if he won't open this discussion.

Mr. G. A. Dean: In view of the fact that insects cause in Kansas an annual loss of not less than $40,000,000, and that fully $25,000,000 of this amount could be eliminated if the practical methods of control that have been found effective were put into operation, your committee on insects hereby recommend to the committee on agricultural resources the following plans for doing effective work on insect control:

1. Organization of the 25 or more working entomologists of the state into a unit.

a. Office force

Publicity—newspaper articles and circulars

Correspondence

Planning and directing field work

b. Field force

Scouting work

Organization work

Demonstration work

2. Apply the methods of control that are effective and practical to the farmer. This can be done by carrying on a publicity campaign against the insects through farm papers, newspapers, farmers' institutes, granges, farmers' unions, county agents, etc.

3. Send out field men from time to time to keep in touch with any threatening outbreaks and thus be prepared to put methods of control into operation at the most important time.

4. In case of threatening outbreaks, organize the counties for concerted action. These counties can be organized by townships, as thirteen counties were in 1913 for the control of grasshoppers, or by school districts, as more than twenty counties were in 1912 and 1913 for the control of chinch bugs. The counties may be organized through the county farm agents, as several have been for the control of Hessian fly.

5. Have the entomologists in the field to actually direct the field work, because many farmers will not apply the methods which they merely read, or, if they do, will often omit some important step in the work which is vital to its success.

6. Have the county committees furnish to the Committee on Insects the names and addresses of all township superintendents in order that, in case of any insect outbreak, they can assist in the organization of the community and permit us to render help with the least possible delay.

7. Prepare short, concise articles (little more than outline) on the life-history, habits and control measures for the more important injurious insects. Copies thereof should be furnished to members of the committee and to persons employed by it or coöperating with it. The articles can be assembled in bulletin form or left separate, as seems most desirable.

8. So unify and organize all the work over the state that the greatest amount of good can be accomplished with the least expenditure of labor and money.

Mr. M. H. Swenk: The problem, as it is stated here, "How Can the Entomologist Assist in Increasing Food Production?" seems to have two parts. One is, what has the entomologist to do; the other, how can he best do it?

Our President in his address stated that for the country as a whole we have an annual loss of 10 per cent of our crops. I believe this statement was first made by Mr. Marlatt in 1904, and other entomologists have repeated it. I had some doubts about the exactness of this percentage and took pains to verify it in this way: We have one file of economic letters for the past thirty years or more, and it is safe to assume, eliminating variations which may be due to publication of bulletins, that those letters would be a fair index as to insect injury.

Especially for the past fifteen years we have analyzed these and submitted three years to very critical analysis. The three years were 1911, 1912 and 1913. The situation was analyzed carefully for each individual insect which seemed to enter into the destruction of crops that year; an average was taken and we found that for the cereal and forage crops the estimated loss ran pretty close to 10 per cent. In other words, for the state of Nebraska there was a loss of $15,000,000 annually for cereal and forage crops for the past ten years. Mr. O'Kane has further pointed out that there is a great deal of variation in the amount of control which we can bring to bear upon the situation.

Professor Bruner and myself, in going over this problem, figured that a fair average for all cereal and forage crop pests, if the information we now have could be thoroughly and consistently applied, would be about 40 per cent. We have therefore the problem in our state of saving as much as possible of about $7,000,000 worth of cereal and forage crops. That is the problem before us. As to how that can best be accomplished is the next question.

The first step it seems to me is for the entomologist to make an analysis of the situation as it occurs in his own state, to determine the pests which cause the most important losses in that state. This for the most part is a matter which would take only a short time, for the data is already at hand.

The next point is to conduct surveys and investigations and use all sources of information, to ascertain as far as possible the immediate conditions relating to those insects in the state and as far as possible to anticipate outbreaks of insect pests. This can be done in some cases; in other cases it is exceedingly difficult or impossible. As far as it can be done, however, it should be. The next point would be to employ all extension forces of all sorts, looking toward the dissemination of information in advance, or at the time of the attack, which would have a tendency to prevent or control those attacks. This may take the form of bulletins, it may take the form of personal conferences, of addresses before meetings, and perhaps other forms. It may even involve the completion of organizations destined to fight insects, the outbreaks of which can be anticipated. When the insect outbreak actually occurs, it seems to me that the placing of as large a force as possible in immediate point of infestation and the exertion of all energies possible toward the control of the outbreak is, of course, the proper thing to do.

Unsolved problems will, of course, arise. These, where they bear directly and importantly on the problem, should be given immediate and very serious attention.

The extension branch of entomology is one which in the last few

months has grown vastly in importance, with the crisis upon us, and it is now in a formative stage. This, if ever, is the most desirable time to regulate as far as possible the form of organization.

The address of our President was exceedingly illuminative on this point, showing a great diversity in the form of organization. In any event, the organization should be such that the information should come from the entomology departments and they should be responsible for it.

In connection with the growth of this special research work, we should not neglect this because it is important; there is this possible danger: that we may overdevelop, perhaps, under the immediate pressing needs the extension aspect of our problem, and while developing our trackage and rolling stock, we may neglect the power house and find that eventually a discrepancy between the fund of information at hand and the extension of it.

Mr. H. A. Gossard: Since Professor Osborn has not yet arrived, I can state what we have done in Ohio the past season and indicate briefly the conditions under which we work. At present Ohio does not have a department of extension entomology, organized as such, but an effort is being made by the State University authorities to have one in operation the coming summer.

Early the past season, Dr. Herbert Osborn, who by common consent acts as a sort of honorary dean of the entomological forces of the state, invited the heads of the state entomological departments to meet at the University. We here attempted to coördinate a sort of program for extension work.

It so happens in Ohio that economic work has been centered at the Experiment Station and I was, therefore, charged with the special responsibility of executing the general program and carrying out the details according to my judgment as to what could best be done with the limited resources at our command. I was handicapped from the start because of losing two of my experienced men to a sister state, wise enough to pay them more money than I could obtain for them. At the same time a campaign for increased food production was inaugurated by the state executive departments acting conjointly with the extension forces of the State University, and the University authorities made us a visit one day and announced they had provided twenty or more men from the University staff to give body to the organization and that to complete it fifteen or twenty additional men from the station staff must be added to the force. While I was very dubious about the wisdom of reducing my staff any more, in consideration of the seeming emergency and to please those in charge of the state's executive machinery, I consented to release for a time my associate, Mr.

Houser, who had volunteered to take up this work if it was so desired by proper authority. He therefore was a district food commissioner in charge of two counties from April to July 1. The one remaining member of my staff was appointed military instructor in Wooster University and gave four afternoons per week to military instruction. My most dependable help were graduate student assistants in the University, one hundred miles away, whose services were placed at my disposal by Dr. Osborn, they voluntarily assenting to this arrangement.

So we started on a publicity campaign and a survey of entomological conditions, so far as our funds would permit. Fortunately, the publicity campaign had been pretty well shaped up and several of the articles written during the winter while we were yet at peace with the rest of the world.

In my office, each letter is subject-indexed when it is answered. The stenographer's duty is not ended with a letter until the species that happens to be the subject of inquiry has been entered in the index-book in alphabetical order and a record made of the name of the writer, the date, and the locality from which the complaint came. We don't use the card system, it is too bulky, we use a loose-note system, each page having on it from 1 to 30 entries. We have in this way a record of every insect that has ever been a subject of complaint since the station was established. I can, therefore, tell in a few minutes if grasshoppers, Hessian flies or any other insect was present in the state in considerable numbers the preceding year or through any series of years. I can also tell at a glance from what localities they were reported. If I am not satisfied from a casual inspection of the record sheet, I can turn the record over to the clerk and ask that a map be made up from the record and in less than an hour I can have a map in hand which will show the localities from which a pest was reported the preceding year or through a series of preceding years. So I can tell about what to look for in a general way. I predicted in my early reports to Dr. Howard that we would have aphids and we did, but I was not able to specify that the potato aphid would be the conspicuous representative of this group. I was also able to indicate where the wheat-joint worm was located and to say there was little or no threat of Hessian fly or chinch bug. The Tussock caterpillar, canker-worms, curculio, potato beetle and a few others, developed exactly according to my forecast.

One of our first steps was to write to the county agents and district food commissioners, enclosing a list of manufacturers and dealers in insecticides and of makers and assemblers of spraying machinery and urge them to see that our press bulletins were given a place in their county papers; also to make sure there was a plentiful supply of insecticides and spraying materials available to their farmers. A ques-

tionnaire was also sent them regarding the injurious insects most likely to be in sight.

Just before wheat harvest I got a sufficient working staff to make a state survey. With very limited funds, I had judged it to be unwise to dissipate them in aimless wandering about the state to see what might be loose, and, therefore, timed the work to give greatest help to the crop of greatest importance during these war-times, viz., wheat. I believed the acreage could be increased if I could give the growers definite information that they were not seriously menaced by Hessian fly or other wheat insects and could safely do their seeding nearly at their own convenience. I, therefore, started four surveyors at four points on the southern border of the state and instructed them to proceed northward along four parallel lines, devoting approximately one day to each county. In laying out the routes, I paid some regard to the easiest lines of travel but aimed to make the stopping point in each county at a county seat, which was headquarters for a county agricultural agent or a county food commissioner. Then I wrote a letter to each of these county officials informing him of the purpose of the survey and requesting that he give such assistance as possible to the surveyors by way of transportation, information as to the location of the wheat districts, etc. I informed each that a day or two before my surveyor was due to arrive he would make his approach known by a long distance phone call or a night telegraph letter, and if said county officer could not be in his office the day of the surveyor's visit much assistance could be given by leaving a memorandum of the best route with the office clerk or that it might be possible to have arranged in advance a trip with some retired farmer willing and glad to loan the use of an automobile and acquainted with the wheat growers of the county. So far as I recall, every county agent visited personally responded to my request and gave most effective help to all the surveyors. One line of survey was made exclusively by automobile and this was undoubtedly the cheapest and most satisfactory means of transportation.

Each surveyor carried with him blank reports or questionnaires, one of which was filled out for each county and mailed to me or brought in by the surveyor. A hundred or more straws would be examined in each wheat field visited for Hessian fly and jointworm and the average of the day's examinations, supplemented by a general estimate, was taken as the average infestation of the county. Similar examinations were made for wheat midge and inquiries were made at every point for unusual entomological conditions. I gave a write-up of the survey in our September *Monthly Bulletin* which reaches about 50,000 Ohio farmers, published a rather full report of it in the *Ohio Farmer*, and by

means of press bulletins scattered the information through the country newspapers. I wrote a personal letter to about four to six editors in each county, enclosing a copy of the press bulletin and urging them to print it if they had not already done so.

As I remember it, our State Secretary of Agriculture estimates that the wheat acreage of Ohio has been increased from 10 to 20 per cent over last year's acreage. It is of course impossible to tell how much of this result was due to our survey, which was part of a general propaganda engaged in by several state departments to increase the acreage. I sent questionnaires to all county agents not visited, so that we had fairly accurate knowledge regarding all parts of the state. Of our 88 counties, our surveyors personally investigated 56.

We published fifteen or sixteen entomological articles, each from two to twelve or more pages in length, in our *Monthly Bulletin,* making these of a timely character. Part of these were written by the University staff. About 45 press bulletins were published. Our station editor keeps a careful record of how many papers make use of the press bulletins, and he reported to me that some of our bulletins were printed in 77 different papers and were adapted for use by two or three press bureaus. In no cases were the bulletins printed in fewer than from fifteen to twenty papers. We seemed to be getting all the publicity needful. Of course we could not determine very accurately how much of our advice was being used. In some counties, where we had the outbreak of potato aphid, the county agent would be coöperating with the horticultural department of the University, with private concerns like the Kentucky Tobacco Product Company, which had a skilled entomologist on the ground, and with us all at the same time. We only know the totals of such results. In one of our counties the saving was large as recorded in the *Bulletin* on the potato aphid recently distributed from our station.

Perhaps the methods we used are not the best that can be devised but they were the best we could think of to put into operation quickly under the circumstances previously detailed.

President R. A. Cooley: Professor Osborn has arrived and we will now be pleased to hear from him.

Mr. Herbert Osborn: I believe we may all agree that this subject can properly be widened to cover both production and preservation of food. It goes without saying that we, as good Americans, will do everything in our power to support our government in the present crisis and will respond wherever duty may call. It is also evident that a particular phase of entomological work is offered in connection with army service for the medical and sanitary phases of work and in which it may be hoped our training may be utilized. The phase of

work which is presented in this topic is perhaps of equal importance and, in this, entomological service is already recognized as of very great importance. It may be entered with hopefulness and assurance that results of value are being secured.

In this field the service of the economic entomologists may be directed along three or four distinct lines:

First, the pushing of investigations which bear most directly and urgently upon measures of protection and preservation of crops and which, it appears to me, should not be neglected during the stress of demands in fields which may for the moment seem more urgent. We may, I think, very properly, in view of the fact that many of our investigational members have been called into other lines of service, feel impelled to intensify our efforts and especially to concentrate efforts on essentials, leaving the unessential.

Second, an extensive entomological survey, or field scouting plan, for the purpose of determining as accurately as possible the conditions of insect life, the most menacing species for the immediate future and the securing of data upon which we can make recommendations to cultivators in any part of the country or for the country at large. Such data may serve the purpose of determining what crops should be omitted or given particular care or for which special preventive or control measures will be advised at critical times. A special committee with this particular duty, to work in coöperation with the executive agencies, might be of special service.

Third, a very general distribution of information through various channels, the agricultural press, experiment station bulletins, etc., and particularly through extension agencies and county agents which come most directly in contact with the class of people needing assistance in insect control. The special effort here perhaps should be to unify the recommendations made through different agencies so as to avoid the discouraging confusion to the cultivator who is dealing with problems new to his experience.

Fourth, the instruction and training of entomological workers who will be greatly needed to fill the ranks that have been thinned by the calls to the other lines of service. Every entomological teacher should feel that he has a special duty at this time to help in this direction.

There is, it appears to me, a particular opportunity to demonstrate the value of the knowledge we possess concerning the control of insects since there is so general a demand for information from cultivators, especially those who have undertaken the cultivation of small tracts or gardens as a patriotic service. The effect of this on the future demand for entomological information will, I believe, prove to be one

of the most epoch-making features of the entomological situation in connection with the present conditions.

We have, for many years, known a great number of useful control measures which it has been almost impossible to have adopted in a general way but which, once they can be shown to be profitable, will become a part of the general practice amongst fruit-growers, farmers and gardeners. The result, therefore, may be of permanent value as well as meeting a very urgent crisis at the present time.

It will be observed that these different phases of work are provided for in existing agencies, except perhaps for connected or carefully organized provision for the survey work.

PRESIDENT R. A. COOLEY: We will be pleased to hear from Dr. Felt.

MR. E. P. FELT: Especial stress, it seems to the speaker, should be laid upon the possibility of preventing apparently minor and comparatively insignificant losses throughout the country, since in the aggregate these count up tremendously, and in not a few instances the saving can be effected in an incidental manner and without an appreciable increase in cost for either insecticides or labor. These last will be more difficult to obtain in the future and, therefore, are important items in any plan to increase food production.

In this category we would place, possibly first of all, garden insects, especially in the case of small holdings, since here is a place where better control can be easily secured if there is only an understanding of the problems involved and the best methods of controlling the pests. It would simply be another step in making more efficient the millions of small gardeners throughout the country.

The care of stored grains and other food products is another instance along the same lines and if followed out systematically would prove an important aid in supplementing food deficiencies. This can be accomplished by well known methods, such as using up old stocks, the keeping of bins, barrels, granaries, etc., reasonably clean so there will be no centers for reinfestation and the exercise of a moderate degree of care to prevent introduction of infested material.

The adoption of every reasonable precautionary measure against insect attack is likely to be of great value and should be emphasized wherever possible; for example, in some sections of the country white grubs will be very destructive on recently turned sod land next season and the entomologist can render no better service than to make this knowledge generally available to those likely to be affected and thus save unnecessary destruction of susceptible crops, such as corn and potatoes. The efficacy of precautionary measures against such pests as the Hessian fly and the importance of promptly burning trimmings from orchards fall in the same category.

The bearing rotation of crops may have upon insect injuries should be kept in mind and improvements suggested wherever it is possible to secure greater immunity from insect damage without, at the same time, causing loss or injury in other directions. An important point in this connection is that general practice in a locality has doubtless justified itself by experience and one should consider the matter carefully before proposing innovations which in the long run may prove less successful. Preventive measures, as a rule, cost little and in these times of high prices and scarcity of help, expense and labor count for more than under normal conditions.

The value of good and clean culture cannot be too strongly emphasized, since we know that well cultivated crops will frequently outgrow insect injury that would be serious, if not fatal, to those receiving less care, and entomologists can cite numerous cases where the lack of clean culture has resulted in more or less damage, frequently serious, from insect pests. The origin of army worm outbreaks in thick weedy growths is one of the more striking instances, while the less serious damage by stalk borers and some of their allies is intimately related to an abundance of weeds.

Secondly, the entomologist should lay particular stress upon well recognized methods of controlling insects and urge activities along these lines. It is especially desirable that he should be in position, in case it is necessary, to restrict or modify spraying schedules, to indicate beyond question the applications which will give the maximum benefit at the minimum expenditure of time and money. It is particularly desirable that he limit his recommendations to methods which will surely result in benefit and preferably to those most likely to be effective in the hands of the average grower.

The present is an excellent time to question the efficacy of methods frequently recommended for the control of various insects and to ascertain whether in our enthusiasm for the theoretically perfect we may not have overstepped the line of the practical and advised treatments which in many instances would not justify themselves if a careful account was kept of profit and loss. Methods of problematical value may well be held in abeyance until further work has demonstrated their utility. There is a legitimate place for experimentation but for the present we believe, in case of large sized propositions, at least, that it is far better to advise a well-tried method, though it may be less efficient than will probably prove true of one which has not been thoroughly tested.

Now, supplementing that I would state that in New York last year we had an "Insect Pest Survey and Information Service." Through coöperation with county agents and special agents of the

State Food Supply Commission, which was organized for the special purpose of promoting production, and the other scientific agencies such as the Experiment Stations, and Cornell University, etc., we endeavored to keep in close touch with conditions throughout the state and to distribute that information promptly, preferably through county agents, so that anybody in the state would know pretty nearly what was going on, entomologically speaking. When possible we endeavored to forecast and warn as to probable developments. Of course, that is a little bit dangerous. You can't tell whether you guess right or not, but it does seem wise to put the farmers and gardeners on their guard against possible developments, with the distinct idea that they are to watch and then go ahead. Another thing I think has been brought out rather emphatically in our experience during the past year is the great value of the local agent.

We have in our state a farm bureau agent for practically every county, and last summer, under the charge of Professor Crosby, we had entomologists working in important centers.

You gentlemen appreciate as well as I, that it is surprising how many mistakes the average man can make without really trying, and we have found in hundreds of instances a man doing the wrong thing when he thought he was doing the right, and, of course, a concrete saving there means increased production. I believe, generally speaking, that we can accomplish more in conserving food supplies, etc., by emphasizing these comparatively insignificant features than we can by giving considerable attention to some larger and really more important matters. Save the small things and the larger ones will look out for themselves.

Mr. R. L. Webster: Mr. President, it seems to me that this insect survey proposition is one of the most important points that has been brought out in the whole discussion. It leads us to information that we do not get in any other way. We do not get it through our correspondence because the farmers and fruit-growers do not see these things in time, and the college people do not get it because they are not in close touch. I think this is one of the most important things in the whole situation.

Mr. F. C. Bishopp: Mr. President, I think there is one aspect of this question that has not really been touched upon and that is the relation of insects affecting live stock in the production of the meat and food supply. We have a number of instances in which insects have materially cut down the production of the meat foods and the by-products of them. This is a field which is being neglected in practice by the entomologists. It is being left a great deal to the veterinarians who unfortunately minimize the importance of these things.

I might mention a few of the insects which should receive more attention at the hand of the entomologists both at the stations and in the extension work. For instance, in the case of the development of poultry industries, which have received a tremendous stimulus on account of the war conditions—many people are starting in poultry lines for the first time. They have no conception of the various difficulties they will meet. As a result they have lost much. This has been brought about by mites and lice. The ox-warble is responsible for a tremendous loss, lice of various kinds are also responsible for the cutting of growth, and of course, the ticks of various kinds are important.

I think as I said, that we should give a little more attention to this question, especially now that the nation is so hard pressed in the production of the meat and food products derived from animals.

Mr. J. J. Davis: We have had excellent results in our work in collaboration with the county agents. Our plan has been to carry on as much of our work as possible with the county agents. In this connection, when we first go into a county, we take up the entomological problems with the county agents; we learn from them and from personal observation what insects are important ones in that county and what insects are likely to be important ones. We then go over the whole matter with the county agent and make him thoroughly familiar with the different insects and the methods of control. We do this partly to save time for ourselves, because we cannot be in every county all the time. After we have discussed the matter in this way with the county agent so that he can handle it himself, it saves us a great deal of time.

Mr. T. J. Headlee: In regard to the county agent problem, we find that the county agents have organized their counties into community organizations in most of the counties in the state. These community organizations are such that they cover the entire county and are sufficiently close together that when meetings are held at these places, it is only necessary to call the active farmers in the county. Through the development of the telephone service, it is now possible for a county agent to arrange a schedule within twenty-four hours if the need for it is known, and it is possible to get information promptly. The county agents with us have developed as executives—they have come to be the head of nearly all the agricultural organizations in the county. The result is that we have to appeal to the county executive to get things started.

It is perfectly practical to organize any movement necessary for the control of any insect. We know that is necessary. Our problem is one of scouting. We are scouting already for three species and we

expect to scout for at least six or eight more before the next season opens. The scouting problem is a difficult one. The most discouraging thing about the efforts of the Department of Agriculture in the way of extension work, is that it is not providing apparently for this scouting work. Some of the men are trying to handle it under the head of survey work, but I am told that no provision had been made for scouting work and that if any is done it would have to be placed under the head of surveying. That is an unfortunate thing.

President R. A. Cooley: I might mention one or two matters in my own experience. We are all familiar with the fact that many county agents have had more or less entomological training and that they have in many cases come from widely separated states. It is a case of having a little knowledge in some instances, and there is a tendency, we have noticed, for them to make recommendations which might be widely at variance with recommendations which the home institution would make. We are, therefore, undertaking to furnish all county agents with a sheet dealing with an individual pest, briefly outlining the life-history, the recommendations that the state has adopted or we believe should adopt. Another point is mentioning at the bottom of the page a few important bulletins of the home state or of another state, the purpose of this being to make the work generally more effective and specifically to bring about uniformity in the state. These sheets may be recalled from time to time and new ones substituted as additional information is available.

We are hoping to make the work somewhat more effective by this method.

We are grateful to the Horticultural Section for allowing this infringement upon their time and I will now turn the meeting over to them.

Adjournment.

The Section of Horticultural Inspection

The sixteenth annual meeting of the Section on Horticultural Inspection was held in the Carnegie Museum at Pittsburgh, Pa., January 1, 1918, at 1.30 p. m. and 8.00 p. m.

The sessions were called to order by Prof. G. M. Bentley, Knoxville, Tenn., Chairman; with Prof. J. G. Sanders, Harrisburg, Pa., Secretary. The Federal Horticultural Board and committees of the American Association of Nurserymen, and of the Society of American Florists and Ornamental Horticulturists were invited to attend the sessions to discuss and confer on the proposed bill prohibiting the importation of nursery stock from foreign countries. One member of

the Federal Board was present, but the nurserymen and florists were not represented at the sessions.

PROGRAM

January 1, 1918, 1.30 p. m., Carnegie Museum, Pittsburgh, Pa.

Address of Chairman	G. M. Bentley, Knoxville, Tenn.
Important Insect Pests Collected on Imported Nursery Stock in 1917	E. R. Sasscer, Washington, D. C.
Important Diseases Collected on Imported Nursery Stock in 1917	R. Kent Beattie, Washington, D. C.
Devastation by Imported Plant Pests Shows the Need of Quarantines against Foreign Plant Introduction (Illustrated)	J. G. Sanders, Harrisburg, Pa.
Discussion	

January 1, 1918, 8.00 p. m.

Election of officers	
The Control of Imported Pests Recently Found in New Jersey	H. B. Weiss, New Brunswick, N. J.
The European Poplar Canker in the Vicinity of Philadelphia	J. K. Primm, Philadelphia, Pa.
The Work of the Missouri Inspection Service	L. Haseman, Columbia, Mo.
Moving Pictures of Gipsy Moth Work in New England	A. F. Burgess, Melrose Highlands, Mass.

Professor Bentley spoke briefly along two distinct lines of horticultural police work, outlining first those methods successfully employed to improve nursery conditions in Tennessee, referring especially to the use of improved fumigating apparatus and chemicals. The second part of this talk referred to the extreme importance of strict quarantine on imported nursery stock.

At the close of the afternoon's program, which consisted largely of discussions of the desirability of an embargo on imported nursery stock, a special committee was appointed by the Chairman to draft resolutions pertaining to imported plants, these resolutions to be presented at the evening session.

EVENING SESSION, 8.00 P. M.

The special committee on plant importation submitted the following resolution, which was unanimously adopted:

REPORT OF SPECIAL COMMITTEE APPOINTED TO FORMULATE THE ATTITUDE OF THE SECTION ON HORTICULTURAL INSPECTION ON THE QUESTION OF PROHIBITING THE IMPORTATION OF NURSERY STOCK FROM FOREIGN COUNTRIES

WHEREAS our country is now and has for many years suffered serious financial loss from the depredations of insects and plant diseases that have come to us from abroad,—the annual damage by a single insect in some cases being greater than the total value of all nursery stock imported in the course of a year; and

WHEREAS the means of communication between the countries of the world have developed to a point that all regions are now reached through the regular channels of commerce in a portion of the time formerly required; and

WHEREAS by reason of this great improvement in transportation, species of injurious insects now confined to foreign countries, are certain soon to be introduced into our country through the importation of foreign plants; *Be it resolved:*

1. That the importation of all "nursery stock" as designated in the Federal Plant Quarantine Act of August 20, 1912, should be prohibited except as brought in under carefully guarded quarantine regulations of the U. S. Department of Agriculture.

2. That an absolute embargo against nursery stock coming in with soil about the roots should be placed at once.

3. That the prohibition against all other kinds should be placed with due regard to the time necessary to enable the businesses affected to adjust themselves to the change, after which absolute prohibition should obtain.

THOMAS J. HEADLEE,
GEO. A. DEAN,
E. D. BALL,
Special Committee.

Mr. E. C. Cotton, Chief of the Bureau of Horticulture, State House, Columbus, Ohio, was elected Chairman for 1918, and Prof. J. G. Sanders, Economic Zoölogist of Pennsylvania, Harrisburg, Pa., was reelected Secretary.

After the reading of papers, five excellent reels of motion picture film were presented under the direction of Mr. A. F. Burgess, Melrose Highlands, Mass. These reels quickly portrayed in a short period the extension and marvelous amount of good work which has been done in moth control in New England. Few of our entomologists had any adequate conception of the delicate technique required in the promotion of parasite rearing and distribution, and the broad scope and wholesale methods employed in the field work incident to spraying, banding and other phases of control work. This exposition by the motion picture reel method conveyed to the audience more vividly and accurately a knowledge of this work, than could have been furnished in a paper requiring a half day's reading, and we trust is a forerunner of other such illustrative films in the future, and shows the desirability of a more general use of this method of instruction.

THE MISSOURI NURSERY INSPECTION SERVICE

By L. HASEMAN, *Entomologist and Chief Inspector, Columbia, Mo.*

In 1913 the Missouri legislature passed the present inspection law creating in the Agricultural Experiment Station the Nursery and Orchard Inspection Service. The law embodies the essentials of the proposed uniform inspection bill, later agreed upon by the nursery

men and horticultural inspectors and has proven to be well adapted to the needs of the state. Previous to the passage of a definite inspection law, the Agricultural Experiment Station was responsible for nursery inspection and orchard clean-up work in the state and recognizing the great educational opportunities connected with orchard and nursery inspection and clean-up work, the work of carrying out the new law was placed with the Agricultural Experiment Station. Police work of this nature accomplishes but little if not accompanied by educational work. This being true every effort has been made to accompany the police work with field teaching and demonstration work. The inspection service has not merely located San José scale in nurseries and orchards and condemned scaly stock, but it has joined hands with the entomological and horticultural forces of the Agricultural Extension Service and has gone into scale infested orchards and communities and demonstrated scale control as well as orchard pruning, general renovation of old orchards and the use of summer sprays for the control of fruit insects and diseases. Whole counties in the past three years have been redeemed for successful fruit growing, where formerly valuable orchards were being left to the mercy of San José scale, canker and other insects and diseases.

Inspection work from the point of view of police duties alone, without the follow-up work of the inspectors and the extension staff, will never redeem horticulture, where it is so widely scattered in more or less isolated communities as in this state. The duties of an inspection service are not merely to prevent further distribution of scale and other fruit tree pests, but it must help clean up trouble and encourage better horticultural methods generally, or there is little excuse for its existence. This, we believe, is the one thing which has enabled the Missouri Nursery Inspection Service to go forward with its work so successfully under most unfavorable financial conditions.

The state has never provided a cent to maintain the service, yet few states have probably made more rapid strides against nursery and orchard insect pests and diseases in the past three years. The expense of the service has been met by fees paid by our nurserymen, florists and dealers. These fees, we realize, have been inadequate, but with the hearty and enthusiastic coöperation of our nurserymen we have been able to practically eliminate San José scale and the other dangerous pests and diseases from our nurseries and to clean the communities surrounding the nurseries of similar pests, besides practically resurrecting fruit growing in a number of the best horticultural counties. We have also eliminated unscrupulous dealers and we register all agents and outside nurserymen shipping stock into the state. We are now also requiring the attachment of a Missouri tag to all incoming stock.

However, the state is still far from being safe for horticulture. There is an immense field for work still. The results which the Inspection Service has accomplished, through the coöperation of the nurserymen, fruit-growers, county agricultural agents and the other forces of the Agricultural College and Experiment Station, have won for it the confidence and good will and support of the fruit-growers and nurserymen. During the past twelve months the florists have organized the Florists' Association, the nurserymen, the Nurserymen's Association and the State Horticultural Society has taken on new life, and they are all behind the Inspection Service. This will go a long ways to insure adequate financial support from the next legislature. With the continued coöperation of the nurserymen and fruit-growers and adequate financial support, the Inspection Service will be able to carry out its full program.

THE CONTROL OF IMPORTED PESTS RECENTLY FOUND IN NEW JERSEY

By Harry B. Weiss, *New Brunswick, N. J.*

At different times during the past few years attention has been called to various foreign pests which have been found in New Jersey. At first thought, it would appear that this state has been especially favored along such lines or that the inspection service was indeed lax to allow these pests to become established. Such is not the case. During normal years nearly one-fifth of all the nursery stock imported into the United States is consigned to New Jersey. This means that we are in greater danger from an influx of foreign insects than most other states. The report of the Federal Horticultural Board for the fiscal year ending June 30, 1916, places New York first, New Jersey second and Pennsylvania third as to the amounts of stock received from abroad.

The presence of foreign pests in New Jersey is a natural result of the importation of large amounts of nursery stock. These pests have entered in spite of a well developed and well enforced system of inspection. In view of the fact that inspection will not keep everything out, the next best step is to scout continually the nurseries and places where imported stock is consigned in order to locate potential foreign pests. This has been done in New Jersey and as a result various foreign species have been found and are being controlled. This inspection or scouting must be done by trained men, men who are familiar with the native fauna and can recognize new things, men who are interested in entomology or plant pathology for its own sake and who can be trusted to cover the ground faithfully. It is a regrettable fact

that in many cases, inspection work is entrusted to students and to inspectors whose usefulness does not extend further than an ability to recognize San José scale, crown gall, gipsy moth egg masses and brown tail nests. We have tried all kinds of inspectors and have come to the conclusion that considering the importance of inspection it pays to employ competent men. It is true that during the rush seasons we are forced to employ men whose training leaves much to be desired but these men are certainly not placed at danger points.

The finding of various foreign insects in New Jersey during recent years has been due entirely to the activities of competent inspectors. In order to prevent these pests from spreading within the state and to prevent them from being carried outside of the state, various methods of control have been pursued. The following is a list of the more important insects together with the treatment which has been followed in New Jersey.

Gryllotalpa gryllotalpa L. (Orthop.). The European mole cricket has been present for several years in a small nursery area planted to a rose garden and exhibition stock. There is very little danger of this insect being carried out of the nursery in soil around the roots of plants as long as it is not allowed to spread. For the past two years, the entire infested area has been gone over and the egg nests destroyed during June and July. Special men, expert in detecting the nests, do this work and up to the present they have been successful in keeping this European pest down to comparatively harmless numbers.

Monarthropalpus buxi Lab. (Dip.). The boxwood leaf miner has been found in several nurseries and on one estate in New Jersey. On account of unsatisfactory methods of control for this species, infested plants in nurseries are ordered destroyed and certificates are withheld until this has been accomplished.

Evetria buoliana Schiff. (Lep.). This species, known as the European Pine-Shoot Moth, was found several years ago in two nurseries. Certificates were withheld at that time until every infested shoot had been cut off and destroyed. At the present time no infestations are known to exist in nurseries.

Gracilaria zachrysa Mey. (Lep.). This moth, known as the azalea leaf miner, has for the most part confined its attention to azaleas in greenhouses and is not likely to be shipped outside of the state. Spraying with arsenate of lead and fumigation with tobacco extracts have been fairly successful in controlling it.

Plagiodera versicolor Laich (Col.). This Chrysomelid exists in several nurseries and other localities, but feeding as it does in both larval and adult stages on the foliage of poplar and willow, it is readily controlled by arsenicals and is in no danger of being transported on nursery trees.

Popilia japonica Newm. (Col.). Recognized as a pest of grape, beans, peas and peanuts in Japan, this scarabaeid was recently found feeding on roses, ampelopsis, grape, elder, crataegus and button bush in a nursery and on various weeds adjoining the nursery. It was probably introduced into the state in the larval stage in the soil around iris roots imported from Japan. It is regarded as a pest in that country and at present plans are being made in coöperation with the Federal Bureau of Entomology in an effort to exterminate it. In the meantime, precautions have been taken to prevent its distribution in soil around nursery stock.

Diprion simile Hart. (Hymen.). This saw-fly, which was first noted in this country by Dr. Britton, was found in several New Jersey nurseries during the past year or so. In all cases good results were obtained by spraying infested pines with arsenate of lead. Moreover this saw-fly appears to have an effective parasite in the shape of *Monodontomerus dentipes* Boh.

Trioza alacris Flor. (Hem.). This species was introduced from Belgium where it is known as the bay flea louse and where it does considerable damage to the foliage of bay trees. The nymphs curl the leaves and in severe infestations the trees are rendered valueless as ornamentals. At the present writing it occurs only in one nursery in New Jersey and is being brought under control by fumigation with tobacco smoke during the winter. At this time the trees are in storage sheds and hibernating adults are readily killed if the fumigation takes place on warm days when the adults are not completely dormant.

Stephanitis pyrioides Scott. (Hem.). This lace-bug, which is injurious to evergreen azaleas, unfortunately became widely distributed in New Jersey before it was noted. As a result its control outside of nurseries is a difficult problem. It was introduced in the egg stage in azaleas from Japan and is known to occur in Pennsylvania and in the District of Columbia. In New Jersey nurseries it is being controlled by sprayings with whale oil soap in late May or early June after the eggs have hatched.

Peridermium strobi. During 1916 the white pine blister rust was discovered by federal scouts in four nurseries and one estate. At this time a total of 67 pines were found infested. All were destroyed and the blocks in which they were found were placed under quarantine for an indefinite period.

During 1917, our inspectors together with federal scouts found only a total of 15 diseased pines in two of the nurseries where the disease appeared in 1916. No new places were found to be infected. The state has been fairly well scouted over, due to the help which we re-

ceived from the federal Bureau of Plant Industry and it is felt that the outlook for control is fairly hopeful in New Jersey.

Other Imported Pests. At various times during the past few years weevils such as *Acythopeus orchivora* Blackb., *Cholus cattleyæ* Champ., *Cholus forbesii* Pasc., *Diorymellus lævimargo* Champ., and two species as yet undescribed have become established in New Jersey orchid houses where some of them have done considerable damage. Most of them are natives of tropical America and very little is known of their life-histories. As a result hand picking of the beetles or destruction of badly infested parts is practiced.

Another weevil, of European origin, however, which has been taken in New Jersey is *Magdalis barbicornis* Latr. According to Blatchley & Leng (Rhync, or Weevils of N. E. Amer.), this species has been taken also in New York and Massachusetts. In the recently issued government publication, "A Manual of Dangerous Insects Likely to be Introduced in the United States through Importation," it is listed as a pest likely to be introduced in apple, quince and medlar trees and known as the apple-stem piercer. In the above publication which supplies a long felt need, hundreds of foreign insects are listed as likely to be introduced, principally on nursery stock.

Inasmuch as practically all of the nursery stock imported into New Jersey consists of ornamentals, it is interesting to note that 42 species are likely to be imported on alder, that 22 might come in on ash, 60 on beech, 44 on birch, 19 on cedar, 28 on elm, 83 on oak, 16 on linden, 14 on hawthorne, and 227 on various conifers, most of them belonging to the Coleoptera, Lepidoptera and Hemiptera. If importations continue as time goes on, it is not unlikely that we will eventually have all of them in New Jersey.

IMPORTANT FOREIGN INSECT PESTS COLLECTED ON IMPORTED NURSERY STOCK IN 1917

By E. R. Sasscer, *Washington, D. C.*

In spite of the disturbed conditions in Europe during the fiscal year 1917, the five principal European countries exporting nursery stock to the United States offered for entry some three million more plants than was the case in the fiscal year 1913, one year before the war. The following table indicates the amount of nursery stock received from these countries for the past five years.

As the result of state and federal inspection, the following important insects have been intercepted on nursery stock during the calendar year: Egg masses of the gipsy moth (*Porthetria dispar* Linn.) were

TABLE SHOWING THE AMOUNT OF NURSERY STOCK OFFERED FOR ENTRY THE PAST FIVE FISCAL Y[ears]

	1913		1914	
	Nursery Stock	Seed Pounds	Nursery Stock	Seed Po
Belgium	704,927	....	720,891	[illegible]
England	2,578,174	....	2,267,285	
France	30,812,059	....	29,024,187	[illegible]
Germany	[illegible]	7,020	194,186	[illegible]
Holland	5,274,944	....	4,602,954	....

collected on three occasions, once from Belgium and twice from France, hosts not given, and one nest of the brown-tail moth (*Euproctis chrysorrhœa* Linn.) was taken on apple from France. Larvæ of the swan or gold-tail moth (*Porthesia similis* Fuessl) have been found on rhododendron, laburnum, and roses from Holland. According to European writers, this insect is a general defoliator of forest trees, and, such being the case, every effort should be made to prevent its establishment in the States.

Nests of the fruit tree pierid (*Aporia cratægi* L.) have been located in six shipments of deciduous fruit tree seedlings from France. The larva of this insect is a general feeder and is recorded as injuring the foliage of fruit trees, wild rosaceous plants, and oak trees.

Larvæ of the sorrel cutworm (*Acronycta rumicis* L.) have been collected on four occasions, twice on rose stock and once on Cornus from France, and once on azalea from Belgium. It is difficult to predict how serious a pest this would develop into if established in this country. In Europe it feeds on the foliage of strawberries, hops, and various shrubs and trees. The bay psyllid (*Trioza alacris* Flor.) was reported on a shipment of Belgian bays, and the box psyllid (*Psylla buxi* Linn.) and the box leaf miner (*Monarthropalpus buxi* Lab.) have been collected on boxwood from Holland. As in previous years, egg masses of the European tussock moth (*Notolophus antiqua* Linn.) and pupæ of the dagger moth (*Apatela auricoma* Fab.) have been repeatedly taken on miscellaneous French and Holland stock. What appears to be the cocoons of a sawfly (*Emphytus cinctus* Linn.) have been collected on four shipments of roses from England.

Ninety pounds of seed of *Prunus sargentii* from Japan, received in Washington, were found to be slightly infested with *Anthonomus bisignatus* Roel., which, judging from the condition of infested seed, is a very unwelcome guest. This shipment was fumigated in vacuum with carbon bisulphid at the rate of 3 lbs. per 1000 cu. ft. with an exposure of 24 hours. As an additional safeguard, the entire shipment was stratified in boxes covered top and bottom with a 24 mesh per inch wire screen. One of the chaff scales (*Parlatoria chinensis* Marlatt) was taken on *Pyrus sinensis* and *P. ussuriensis* from China. The

BY THE FIVE PRINCIPAL EUROPEAN COUNTRIES EXPORTING PLANTS TO THE UNITED STATES

1915		1916		1917	
Nursery Stock	Seed Pounds	Nursery Stock	Seed Pounds	Nursery Stock	Seed Pound
1,114,089	......	1,065,864	20	812,101	......
[illegible],911,901	......	2,872,745	5,625	3,108,143	5
41,[illegible]01,161	40,053½	38,202,978	30,210	25,757,912	54,820
177,994	821¾	....	82	....	......
[illegible],539,416	6	9,562,421	......	13,915,087	......

introduction and establishment of this coccid into the States would be a misfortune, since in China it is apparently a serious pest, having been collected in large numbers on crab-apple, Hibiscus, Zizyphus, and *Thuja orientalis*. Chestnut trees from Japan exhibited galls made by and containing living larvæ of a species of *Agrilus*, and azaleas from Belgium and Holland were infested with the azalea leaf miner (*Gracilaria zachrysa* Meyrick).

Plants of tropical or subtropical origin have also brought in a number of insects, which, if allowed to become established, would seriously handicap some of the new industries, which in recent years have given so much promise. The mango weevil (*Sternochetus mangiferæ* Fab.), one of the most injurious mango insects in tropical countries, was collected in seed from India, and *Coccus mangiferæ* (Green) arrived on the same host from Cuba. Several shipments of Guatemalan avocado seed have shown infestation with a species of *Stenoma* and also what appears to be an undescribed species of *Conotrachelus*. Both of these insects make deep ramifying tunnels in the seed and are no doubt fully as destructive as the avocado weevil. Avocado cuttings from the same country were infested with the following coccids: *Aspidiotus subsimilis* Ckll., *Aspidiotus* sp. (near *cocotiphagus*), *Chrysomphalus scutiformis* (Ckll.), *C. personatus* (Comst.), *Pseudoparlatoria ostreata* Ckll., *Lepidosaphes mimosarum* (Ckll.), *Diaspis* sp., *Ceroplastes* sp., *Solenococcus* sp., *Lecanium* sp., and *Coccus* sp. Judging from the amount of sooty mould on the cuttings at the time of arrival, it is evident that the *Coccus* secretes honeydew copiously and doubtless represents a very undesirable introduction.

The fig scale, *Lepidosaphes ficus* (Sign.), was intercepted on fig trees from Spain. This fig pest of Europe was introduced into California about seven years ago and is now thoroughly established, being distributed over a tract of some one hundred acres. The papaya fruit-fly (*Toxotrypana curvicauda* Gerst.) was taken in fruit of the papaya from Cuba; cocoanuts from Ceylon were infested with *Phenacaspis eugeniæ* (Mask.); bamboo from Japan was infested with *Antonina crawii* Ckll., and the sugar-cane mealybug (*Pseudococcus sacchari* Ckll.) was received on sugar-cane from Jamaica, Trinidad, and Hawaii.

No less than 73 distinct species of insects have been collected on orchids during the past calendar year, 64 of which were of South American origin. Of this number, there were 20 species of ants, the majority of which are now established in this country. However, there are certain forms which have not gained a wide distribution, and every effort should be made to prevent their further introduction and spread. For example, *Pheidole anastasii* Emery, which was in *Phormium tenax* from the Azores, has in recent years become a very troublesome pest in the greenhouses of the Department of Agriculture, harboring and transferring mealy-bugs and aphids from plant to plant. The so-called "crazy ant" (*Prenolepis longicornis* Latr.), an introduced species, has also been intercepted on incoming nursery stock. This ant has acquired a foothold in the Gulf States and is a household pest as far north as Boston. A species of *Iridomyrmex* was found in a shipment of *Theobroma cacao* from Java and, if allowed to become established in the United States, would eventually be a very troublesome pest, if one is to judge from the activities of the Argentine ant.

In addition to the ants, what appears to be an injurious Pyralid larva was collected in four shipments of Colombian orchids. The Cattleya midge (*Parallelodiplosis cattleyæ* Felt) was collected in orchids from Brazil, Colombia, Guatemala, and Mexico, and 15 species of scale insects were taken on shipments from Panama, Guatemala, New Zealand, Colombia, Philippine Islands, Costa Rica, England, Jamaica, Venezuela, and Brazil. Since 1912 137 species of insects have been collected entering on these plants, including 41 scale insects, only 13 of which are now established in this country. In an effort to prevent the further introduction of these pests, all orchids arriving from countries without a recognized inspection service are being fumigated at the port of entry.

The following list indicates, by countries, the number of species of insects reported by state and federal inspectors from December 16, 1916, to December 16, 1917.

Number of Species of Insects Collected by State and Federal Inspectors and Reported from December 16, 1916, to Date

(Prepared from reports received to December 16, 1917)

Guatemala	48	England	21
Colombia	47	India	14
Holland	46	Venezuela	14
Cuba	36	Argentina	11
China	33	Philippine Islands	11
Japan	29	Hawaii	10
France	28	Australia	9
Brazil	27	Curacao, D. W. I.	9
Belgium	24	Trinidad	9

Java	8	British Guiana	2
Jamaica	7	Canada	2
Mexico	7	Denmark	2
Antigua, B. W. I.	6	Palestine	2
Italy	6	Porto Rico	2
New Zealand	6	South Africa	2
Bermuda	5	Virgin Islands	2
Costa Rica	5	Angola, Africa	1
Egypt	5	Canary Islands	1
Straits Settlements	5	Ceylon	1
Algeria	4	Dominica, B. W. I.	1
Canal Zone	4	Dominican Republic	1
Ecuador	4	Madeira	1
Haiti	4	Mauritius	1
Panama	4	Natal	1
Paraguay	4	Newfoundland	1
Spain	4	Nicaragua	1
Azores	3	Northern Nigeria	1
Bahama Islands	3	Portugal	1
Honduras	3	Reunion	1
Peru	3	Russia	1
Saint Lucia, West Indies	3	Turk's Islands	1
Scotland	3		

THE EUROPEAN POPLAR CANKER IN THE VICINITY OF PHILADELPHIA, PENNSYLVANIA

By James K. Primm,
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While inspecting the nurseries of Pennsylvania in the summer of 1917 a good opportunity was afforded to become acquainted with the disease known as European poplar canker (*Dothichiza populea*). In only one of the numerous nurseries growing poplar trees within a radius of thirty-five miles of Philadelphia this fungous had not become well established. Trees of all ages were attacked, one- and two-year-old stock much less seriously, however, than trees three or four years of age. This apparently higher resistance in young trees, noted especially in Carolina poplars, is modified by the fact that younger trees are damaged less by storms and have not been topped or pruned to any extent. The degree of infection varied from single isolated twig cankers to numerous and confluent trunk cankers. The most virulent attacks were on trees that had been pruned close to the trunk to a height of three to five feet.

The resistance of young trees is even more marked by the slight percentage found to be affected when comparison is made with older stock. In one-year stock only 2 or 3 per cent were found to be infected.

Considerable increase was noted on two-year trees, and while variable, about 18 per cent of the two-year stock was usually affected with isolated cankers on the trunk or limbs. In three-year stock and older, over 50 per cent was found to be cankered while in some blocks of two or three hundred trees, none were found free from the disease, and the greater part were wholly or partially dead from the severe attacks of numerous trunk cankers.

The species of Populus found to be attacked by Dothichiza are the following: *P. nigra* var. *italica*, Lombardy poplar; *P. alba* var. *pyramidalis*, Bolle's poplar; *P. balsamifera*, balsam poplar; *P. trichocarpa*, black cottonwood; *P. deltoides*, cottonwood; *P. eugenei*, Carolina poplar; *P. angulata*, hybrid Carolina poplar. Of these all but the first two mentioned are meeting with less favor as shade or ornamental trees and are being gradually discarded by nursery men. Another species not mentioned in the list, like Japan poplar (*P. maximowiczii*) was found in two nurseries and should meet with more popularity on account of its attractive foliage, its shapely head, its hardiness, and the fact that none had been attacked by Dothichiza. Some inoculations were made by Mr. F. M. Trimble of the Pennsylvania Bureau of Economic Zoölogy, to test the immunity of this tree. The results of these inoculations will be of interest this coming spring. If any conclusions can be drawn regarding the relative susceptibility of the various species of poplar attacked, they would receive the most support from a comparison of the number of diseased trees of each species, and the relative virulence of the attacks. That the Lombardy poplar is the most susceptible seems borne out by the fact that this species has the greatest percentage of infected trees. The degree of virulence is fully as great, however, in all of the other species subject to the canker, with the exception, perhaps, of the Carolina poplar. The latter species was able to produce such a vigorous growth of cambium that in most cases the wounds produced by the canker were entirely healed over. On the other hand, where heavy pruning offered many wounds on the trunk for the entrance of the spores from which cankers developed, the trees were unable to overcome the injuries.

Nurserymen have noted cankers on Lombardy poplars for several years, and estimates ranged from three to thirty years. No serious affection among poplars was reported, however, until 1915, when "a badly diseased condition of black poplars was reported to the U. S. Department of Agriculture. In the spring of 1916 numerous complaints were received of a serious blight on freshly transplanted black poplars."[1] The presence of *Dothichiza populea* was found to be

[1] Hedgcock, Geo. C. and Hunt, N. Rex. *Dothichiza populea* in the United States. Mycologia, vol. VIII: 300–308.

responsible in each case. The indications are that the fungous has been present much longer than these first reports would indicate. Whether the cankers produced on Lombardy poplars thirty years ago, as stated by two nurserymen of this state, were produced by Dothichiza, is very doubtful. Other canker-producing fungi are quite common on both poplars and willows, while *Schizoneura transversitatis* sometimes induces a condition almost identical with a healed over canker.

The typical injury from the poplar canker results directly from the death of the cambium in the infected area. Unless a canker completely encircles the trunk, the tree may live for several years and even when badly attacked by a number of cankers, there is often sufficient vigor left for new growth to be produced and for maintaining a scarred and unsightly existence. Each year the dead branches become more numerous and conspicuous, the beautiful spire-shaped outline of the tree is destroyed, unsightly water sprouts form below the cankered areas, the dry leaves hang on late in the fall and the trunk is likely to be snapped in two by slight wind storms. Again the whole top of the tree may be killed immediately by an encircling canker and oftentimes the whole tree. If the outer bark is stripped from a badly diseased tree, the irregular brown colored areas where the cambium has been killed are readily seen. Cankers often form at the base of the lateral branches and one after another the branches become infected and die.

The cankers first appear as depressed and slightly darker areas of bark, their greatest dimension usually parallel with the axis of the trunk or branch. They are usually tapering at the ends and may occur anywhere on trunk or limb but in most cases about the base of branches or twigs or where conspicuous wounds have been made. As the canker becomes older it may cover quite an extensive and irregular area. One canker mentioned by Hedgcock and Hunt, was twelve inches long and encircled the trunk of the tree for nearly two-thirds the length of the canker. Incipient cankers have been found by the writer in the wounds made by the egg punctures of the Buffalo tree-hopper. It is also significant that in a block of balsam poplars which were seriously infested by the poplar weevil (*Cryptorhynchus lapathi*), every tree so infested was also badly cankered, while some Lombardy poplars in a block adjacent and not attacked by the weevil were correspondingly free from the canker.

Soon after the development of the sunken areas, in April and May, numerous pustules or blisters push up from beneath the bark. These rupture in a short time and a sticky, amber-colored mass of spores exude, which dry up a month later and assume a darker walnut brown

color. These masses of spores, being in a sticky mass, at first might readily be carried by mammals, birds, or insects, and later when they have dried, are disseminated by the wind. After June the course of the disease is arrested until the following spring, wherein it is unlike the chestnut blight (*Endothia parasitica*), although in April or May these diseases have such points of similarity as the yellow exuding mass of spores, the crumpent pycnidia, and the sunken areas of diseased bark.

Affected trees at once attempt to repair the wound and by July and August may have progressed so far as to entirely cover the open wound with a growth of cambium, which in such cases forms a knot of varying size. In every case where this is cut into, the dead area caused by the canker is easily exposed. The disease continues to progress the following year, although apparently healed over after the first attack. Where trees have been weakened year after year by attacks of the canker, they become unable to counteract the disease by a fresh growth of cambium. Large unhealed cracks and fissures remain in the bark and the tree soon dies.

Dothichiza populea was first described and named in 1884 by Saccardo and Briard. In 1903 Delacroix ascertained that the fungus was parasitic in nature and was the cause of a serious disease attacking *Populus nigra*, *P. deltoides* and *P. bolleana*. Hedgcock and Hunt of the Bureau of Plant Industry have made the most extensive studies of this and other poplar diseases in the United States and have contributed the only literature on the subject in this country, consisting of a short paper in vol. VIII of *Mycologia* for November, 1916. These writers conclude that the disease was probably imported on nursery stock previous to the enforcement of the present inspection laws and that it is a somewhat recent disease in the United States.

The disease was by no means confined to nurseries. The trees in private estates in many cases were seriously attacked, and very few of the trees along roadsides or the railroad right of way had escaped it. A systematic course has been pursued with reference to the disease in nurseries of this state. All blocks of poplar have been carefully examined and diseased trees have been marked for removal. The various nurseries have coöperated cheerfully in this destruction of cankered trees. This treatment has been severe, but no other means of control could be more efficient. In the only nursery of the eastern section of the state which had poplars entirely free from the canker, the trees were regularly sprayed every winter with lime sulphur. In no other nursery had the poplar trees been sprayed. This would indicate lime sulphur as a helpful fungicide. Landscape architects now specify that Lombardy poplar trees must be branched from the

base up, while heretofore the basal branches have been cut off close to the trunk. This will doubtless have the effect of decreasing the disease. It seems wise to recommend that poplar trees should not be pruned to any great extent in any part. Poplar trees should have good drainage and proper precautions should be exercised against the use of cuttings from diseased trees. In blocks of poplars growing on lowlands the virulency of the disease was greater.

The utility of the Lombardy poplar for screening unsightly objects or for giving accent to an otherwise monotonous group of trees or shrubs is recognized by nurserymen and landscape architects. Its popularity as a tree for framing in a view is not questioned and they are often very effective for planting close against houses, particularly of the English style. While no other substitutes could fill all the conditions desirable in trees of this type, there are several trees of similar habit and more permanent beauty. The maiden-hair tree (*Gingko biloba*), the Katsura tree (*Cercidiphyllum japonicum*) and the pyramidal varieties of sugar maple, English oak and the tulip tree comprise a list which should suggest a worthy substitute in case the poplar canker does not prove amenable to treatment.

IS CROWN GALL INJURIOUS TO APPLE NURSERY STOCK?

By S. B. Fracker, *Assistant Entomologist, Madison, Wis.*

Under Wisconsin conditions the presence of crown gall and hairy root on apple trees is the cause of a greater commercial loss to the nurseryman than any other disease. The toll taken by the required destruction of all trees infected with it is very heavy. At the same time there is a real doubt in the minds of the nursery proprietors as to the serious or injurious nature of the trouble.

This doubt is increased by the published results of experimental plantings in New York,[1] by the opinion expressed in a U. S. Department of Agriculture bulletin[2] that the effects of crown gall have been greatly exaggerated, and by the fairly well advertised presence in a neighboring state of a flourishing orchard planted entirely with trees bearing large galls.

The writer, therefore, during the last autumn packing house inspection seized the opportunity of making some observations in regard to the relative size of infected and non-infected nursery trees. In all cases the grading into sizes was done by the nurseryman himself and

[1] F. C. Stewart, N. Y. Ag. Exp. Sta. Bul. 328 (1910), pp. 311, 312.
[2] Hedgcock, U. S. Bur. Plant Ind. Bul. 186 (1910), p. 72.

the determination of the presence of crown gall made by the author. All indications of an infection were included, although a small gall or one on a lateral root does not cause the tree to be condemned under our present regulations.

Observations were made in four nurseries, two of which use three grades in addition to culls and two admit only two grades. In all cases the lowest size above the culls is sold for a very low price—below cost of production—while all the profit must be made on trees of the first or first and second grades as the case may be. Consequently, in the following figures the culls and lowest grade trees are added together.

In the two nurseries using three grades, a total of 596 trees (chosen at random, "nursery run") were classified as to infection and size. Three varieties were used—Duchess, Fameuse, and Transcendent crab—with results as follows:

	Number Ones		Number Twos		Threes and Culls		Per Cent Ones and Twos	Total
	No.	%	No.	%	No.	%		
Clean	229	65.1	49	13.9	74	21.0	79.0	352
Infected	92	37.7	77	31.6	75	30.7	69.3	244
Totals	321	...	126	...	149	...	...	596
Superiority of non-infected trees	...	27.4%	...	...	...	...	9.7%	...

This table indicates that out of 1,000 trees not infected with crown gall the nursery might expect 651 trees of the first grade and 139 of the second, a total of 790 trees which would pay the cost of production. In 1,000 infected trees, however, only 377 would be first grade, 316 second, a total of only 693 trees which would pay for raising. If we assume that the best apple trees are worth ten cents apiece wholesale and that the "seconds" are worth three-fourths as much as the "firsts" the value of 1,000 non-infected trees would be $\$65.10+(\frac{3}{4}\times\$13.90)=\$75.52$. One thousand infected trees, if allowed to be sold, would be worth $\$37.70+(\frac{3}{4}\times\$31.60)=\$61.40$, a reduction of 18.7 per cent in value.

In one of the nurseries selling only *one* grade of trees at a profit the figures, mainly for Duchess, are as follows:

	Number Ones	Seconds and Culls	Totals	Per Cent Number Ones
Clean	147	58	205	71.7
Infected	125	86	211	59.2

In this case infection in the 416 trees examined apparently reduced the profitable trees from 717 per thousand to 592 per thousand, a reduction of 17.4 per cent in value.

The fourth nursery usually has so few infected trees that the method employed in the others was scarcely available here. In one variety of their own production, however, which they had been careless in grafting, between 50 and 60 per cent of the "seconds" proved to be infected with crown gall but only about 10 per cent of the "firsts."

Summary

In the first three nurseries discussed, 1,012 apple nursery trees were examined for crown gall and hairy root and graded into sizes. They indicate that the infected trees, if their sale was permitted, would yield 17 to 18 per cent less gross return to the nursery than a similar number of non-infected trees. This is in spite of the fact that the largest of the infected trees were usually as large and apparently as strong as the non-infected ones. In taking the figures the separate nurseries and varieties were tabulated separately and not a single nursery or variety shows as great a proportion of trees of salable size among those with crown gall as in those without the disease.

An interesting point in connection with the inspection at the first two nurseries, both of which make a practice of providing their customers with two grades of stock, was the great diminution in the number of first grade trees when infected and the increased number of seconds. In many cases there seemed to be a tendency for the infection to decrease the vigor of the plant without severely forcing its size down below commercial value.

The correlation between small size and infection might be said to be due to a possible greater susceptibility of weak trees. Phytopathologists, however, state that the reverse is true and only strong actively growing tissue will support the disease. In view of the marked deleterious effects of crown gall in the irrigated orchards of the west, it seems most likely that this reduction in size in Wisconsin nurseries is a direct result of infection.

(Papers read by title)

STUDIES ON THE LIFE-HISTORY OF TWO KANSAS SCARABÆIDÆ (COLEOP.)[1]

By Wm. P. Hayes, *Assistant Entomologist, Kansas State Agricultural Experiment Station*

Introduction

The study of the two species under consideration, *Cyclocephala villosa* Burm. and *Anomala binotata* Gyll., is a continuation of the life-history investigations of Kansas white grubs. The synonymical status of *Cyclocephala villosa* Burm. is in question because of its similarity to *Cyclocephala immaculata* Oliv. In a large series of specimens, intermediate forms show a gradation from one species to the other. Horn (1871, p. 337) separated *C. villosa* from the synonymy of *Melolontha angularis* Knoch where it had been previously placed. If *C. immaculata* and *C. villosa* are found to be synonymous, *immaculata* should take precedence because of priority. However, the writer chooses to call the species *villosa*[2] on the authority of Swenk (1911, p. 285) who states that *villosa* is the most abundant species in Nebraska, an adjoining state.

With *Anomala binotata* Gyll., three species, *unifasciata* Say, *marginella* Lec., and *luteipennis* Lec., have been united by Horn (1884, p. 164), the latter being a variety with the elytra not as rough, more shiny and without the usual spots.

Cyclocephala villosa Burm.

General Considerations.—The genus *Cyclocephala* contains some of our common and most injurious white grubs. Forbes (1891b, p. 40) reports the grubs of *C. immaculata* infesting grass-land, corn on sod, roots of corn, and young oats. Titus (1905, p. 14) found them at the roots of grass and sugar-cane stubble, and Riley (1870, p. 307) recorded them in strawberry beds. Davis (1916, p. 264) states: "*Cyclocephala immaculata* is frequently found in compost heaps and in cultivated fields, and may obtain its full growth on decaying matter alone or may become a serious field pest, damaging crops similar to those attacked by *Lachnosterna* grubs." Under the name *C. villosa*,

[1] Contribution from the Entomological Laboratory, Kansas State Agricultural College, No. 31. This paper embodies the results of some of the investigations undertaken by the author in the prosecution of project No. 100 of the Kansas Agricultural Experiment Station.

[2] Specimens sent to J. J. Davis were determined as *Cyclocephala villosa* Burm.

Swenk (1913, pp. 86–87) reports the larvæ doing severe damage to winter wheat in Nebraska. He says: "The same condition was common in many fields in the southeastern part of the country, namely, that the plants had commenced dying about the first of September and in the next month had died out completely or at least had only a scattered sickly stand remaining. The soil in these fields was fairly alive with the *Cyclocephala* larvæ. Over fifty were turned out in a space less than two feet square and not all of them were secured." The writer has taken the grubs in corn, wheat, and oat fields, in grass of lawns, and sod of orchard and pasture land. Meager accounts are found in the literature of the life-history of *C. immaculata*. The following observations on *C. villosa* were made in Kansas during the past two seasons:

The Egg.—The eggs are pearly white and nearly round, being slightly longer than wide. When freshly laid, they are about 1.2 mm. wide and 1.7 mm. long. They continue to increase in size as development proceeds, but gradually lose their oval shape until a nearly round form is assumed, at which time they are about 2.1 mm. in diameter. An average measurement of thirty eggs, chosen at random from eggs of various stages of growth, was found to be 1.7 mm. wide and 1.95 mm. long. Eggs are laid in the ground, generally in small clumps of soil. The exact number of eggs laid by an individual female has not been definitely determined. Three females, mated in rearing cages, afterwards laid 21, 16, and 10 eggs apiece. In each case, these females had been collected at lights and may have mated and laid eggs previously. Table I shows the number and time of egg laying by these individuals, and the interval between mating and oviposition.

Table I—Oviposition Record

No.	Date Mated	Number of Eggs Laid							Number of Days between Mating and Oviposition
		July 18	July 21	July 24	July 29	Aug. 3	Aug. 5	Total	
1	July 5	..	6	4	..	..	..	10	16
2	July 12	..	8	3	5	..	..	16	9
3	July 12	3	2	..	4	10	2	21	6

In life-history cages, egg laying by females collected at lights began, in 1916, on July 3, and, in 1917, on July 11. In each instance, the period of oviposition extended over 31 and 44 days, respectively. Individuals becoming adults after July 20, 1917, began to lay eggs August 1, 1917. Table II shows the variation in the length of the egg stage for the two seasons.

The Larva.—Previous to hatching, the body segments and the brown mandibles of the young larva can be discerned through the

Table II.—Incubation Period

Date	No. Eggs Hatching	Minimum Days	Maximum Days	Average Days
1916	51	9	23	13
1917	56	13	25	18

shell of the egg. When hatched, the grub is about 2 mm. long and, except for the mandibles, is entirely white. In a few hours the entire head begins to darken until it has assumed its final brownish color. The grubs when full grown are about 23 mm. long and 6 mm. through their widest part, and are creamy white in color. In their characteristic doubled-over position, they appear about one-half as long or about 12 mm.

The grubs of this genus are distinguished from those of *Lachnosterna* by the absence of the median longitudinal double row of mesad pointing spines on the last abdominal segment of *Lachnosterna* and by a transverse anal slit which in *Lachnosterna* is V-shaped. According to Davis (1916, p. 266) the *Cyclocephala* grubs resemble those of *Cotalpa*, with which they are more apt to be confused.

As the time of pupation approaches, the grubs shed the meconial mass in their alimentary tract and appear to shrivel up somewhat, cease feeding, and become generally inactive, forming the prepupal stage. Table III gives the length of the complete larval stage as it occurs in Kansas.

Table III.—Development of Grubs from Hatching to Pupation

Serial No.	Hatched	Became Prepupa	Pupated	Length of Prepupal Stage (days)	Complete Time of development (days)
	1916	1917	1917		
1895	July 15	June 23	June 30	7	350
1896	July 15	June 26	July 1	5	351
1898	July 16	July 6	July 12	6	361
1899	July 16	June 28	July 5	7	354
1902	July 16	June 27	July 5	8	354
1903	July 17	July 10	July 16	6	364
2246	July 22	July 5	July 11	6	354
2247	July 22	June 28	July 5	7	348
2356	July 23	June 26	July 5	9	347
2361	July 24	June 26	July 1	5	342
2945	July 27	June 23	July 1	8	339
3036	Aug. 1	July 1	July 8	7	341
3038	Aug. 1	June 26	July 5	9	338
3040	Aug. 2	June 30	July 7	7	339
3041	Aug. 2	June 26	July 3	7	335
3042	Aug. 2	July 7	July 13	6	345
3083	Aug. 2	July 9	July 16	7	348
				Average 6	347

The average time of complete development for 17 individuals was 347 days, with a minimum of 335 days and a maximum of 364 days. The prepupal stage has an average length of 6 days, with a minimum

of 5 days and a maximum of 9 days. In 1916, the first larvæ hatched July 15 and, in 1917, July 24. The winter is passed as a larva and the following summer the grubs transform to pupæ. Grubs were fed from the time of hatching to the prepupal stage on germinating grains of wheat, except during the winter when they were in a dormant condition. The larvæ were found infesting corn, wheat, and oat fields, as well as sod of lawns, orchards and pastures.

THE PUPA.—The pupa is about 17 mm. long and 8 mm. wide. When freshly transformed, it is creamy white with a faint trace of brown on the legs, wings, head, thorax, and tip of abdomen. Gradually, the pupa darkens to a reddish brown. It lies, as a rule, in the old larval moult which splits at the time of pupation from the epicranial suture backwards over the dorsum of the grub.

In 1916, pupation began in soil cages on May 27 and continued until the middle of July. In 1917, pupation did not begin until June 30, and lasted until August 6. Pupæ were collected in the fields during late June, checking closely with the time of pupation in life-history cages. Table IV gives the length of the pupal period of 13 individuals reared from eggs.

TABLE IV—LENGTH OF PUPAL STAGE

Serial No.	Pupated	Became Adult	Length of Stage	Sex
	1917	1917		
1895	June 30	July 21	21	♂
1896	July 1	July 21	20	♂
1899	July 5	July 23	18	♂
1902	July 5	July 22	17	♂
2216	July 11	July 27	16	♀
2356	July 5	July 21	16	♂
2361	July 1	July 20	19	♂
3036	July 8	July 26	18	♂
3038	July 5	July 23	18	♂
3040	July 7	July 25	18	♂
3041	July 3	July 22	19	♂
3042	July 13	July 28	15	♀
3083	July 16	Aug. 2	17	♂
			Average 17	

The average time of development was 17 days, with a minimum of 15 days and a maximum of 21 days. The average of 33 other individuals reared from grubs collected in the fields was 16 days, with a minimum of 8 days and a maximum of 24 days.

THE ADULT.—Newly emerged adults have a pale creamy tinge which soon darkens to a normal dull yellow color. They are from 11 to 14 mm. long and 6.8 mm. wide and have the surface sparsely covered with fine hairs. The elytra and thorax are somewhat finely punctuate. Males are distinguished from the females by an enlargement of the fifth joint of the anterior tarsi and a somewhat longer antennal club.

The adults fly at night and are strongly attracted to lights. The

first appearance of the beetles at lights was June 12, in 1916, and June 29, 1917. In the first instance, a maximum flight was reached near the last of June, while, in 1917, the maximum was attained near the middle of July. The flight during both years extended to near the middle of August. Mating takes place in the daytime and in life-history cages was several times observed on the surface of the soil. The male uses the enlarged tarsal joint to clasp the female on the edge of the elytra behind the legs. Unlike the position assumed in *Lachnosterna*, the females of *villosa* do not remain motionless but will move about carrying the males on their backs. If disturbed while mating, they hasten to burrow into the soil. The food of the adults has not been definitely determined. None were taken on trees among daily collections made last summer. A few individuals were collected at night on the common pigweed (*Amaranthus* sp.) upon which they were apparently feeding.

To summarize, the life cycle of *C. villosa* is one year. Adults appear at lights in June, July, and early August. Eggs, which are laid in soil, hatch after 9 to 25 days. The larva passes the winter in hibernation. The larval stage was found to average 347 days. The pupal stage varied in length from 8 to 24 days.

ANOMALA BINOTATA Gyll.

GENERAL CONSIDERATIONS.—In the adult stage, this species is known as a leaf-eater. In the grub stage, its depredations are not so familiar. However, they are thought to feed on living rootlets (Davis, 1916, p. 265) and may often occur in sufficiently large numbers to damage crops. Webster (1891, pp. 345–346) records adults feeding on strawberry blossoms and later (1892, p. 197) on blossoms of blackberries in large numbers. He also cites an instance of a fly (*Laphria tergissa*) capturing and flying away with a beetle of this species in its grasp. Lugger (1899, p. 175) lists *binotata* in his work on insects injurious to fruit-producing plants. Johnson (1900, p. 84) records three instances of the beetle feeding on foliage of pear and apple trees. Chittenden (1902, p. 100) states that *binotata* is one of the vine-chafers injurious to grapes, strawberries, and locust, and later (1903, p. 732) adds that they were injurious to roses in 1902. Pettit (1908, p. 122) recommends spraying with arsenites after having found the beetles injuring young apple foliage. Hart (1911, pp. 73–75) records more observations on this species than any American writer. He noted from 30 fields in which pupæ and adults were found, 29 of them had been in oats. A note before the writer shows that out of 126 beetles maturing from larvæ collected in fields, 115 individuals were taken in oat fields. The remainder were from wheat and corn land. Felt

(1913, p. 106) found the beetles in strawberries being shipped into New York, and Swenk (1913, p. 87) mentions the insect as a minor wheat pest in Nebraska where he found them in large swarms alighting on wheat and trees and shrubs of all kinds.

THE EGG.—The eggs of this species are pearly white and have a distinct shining luster. They are slightly longer than wide, being somewhat oval in appearance. When freshly laid, they are about 1.6 mm. long and 1.2 mm. wide. As development progresses, the eggs increase in size until they attain an average size of about 2.5 mm. long and 2.0 mm. wide. Oviposition occurs during the early part of June, the eggs being laid in the soil. A number of eggs found in life-history cages on June 15, but which had been laid some few days previous, hatched from 7 to 11 days later. Shortly before hatching, the brown tips of the mandibles and faint outlines of the body of the embryo larva can be seen through the egg shell.

THE LARVA.—The young larvæ upon hatching are about 2.5 mm. long and are entirely white except for the tips of the mandibles which are brown. When full-grown, they are about 20 mm. long and 7 mm. wide at the thorax. They taper toward the posterior end and are creamy white with a pale yellow, finely reticulated head. The spiracles are likewise pale yellow in color. The posterior ventral segment bears a triangular patch of short hairs with a centrally located longitudinal double row of prostrate spines. Dorsally, this particular segment bears longer and much finer hairs. The other dorsal segments are covered with short, brownish, bristle-like hairs interspersed with finer and longer hairs. Concerning these grubs Davis (1916, p. 266) writes: "The grubs of *Anomala*, *Listochelus*, and *Phytalis* are very close to those of *Lachnosterna* and we are at present unable to satisfactorily distinguish between grubs of these four genera except by direct comparison, but no doubt substantial characters will be found when we have obtained a sufficient number of grubs of the first three mentioned genera." The first larvæ hatched on June 22. The length of the larval stage, inclusive of the semi-pupal stage, was found to average 83 days, with a minimum of 80 days and a maximum of 86 days.

When near pupation the grubs shed their meconium and appear to become shorter and broader. This is the initiation of the so-called prepupal stage. Faint traces of black waste matter are still to be see in the alimentary tract. The posterior abdominal segment appears much depressed and greatly wrinkled. This condition is likewise found to a lesser degree in the penultimate segment. The prepupa lies coiled on its back and when disturbed wriggles about on its side, alternately straightening and coiling the body. The length of the prepupal stage varies from 6 to 10 days with an average of 7 days.

Grubs were reared from the egg to prepupa in common salve boxes by feeding them germinating grains of wheat, the roots of which apparently offered sufficient sustenance. Larvæ were collected abundantly in oat land and doubtlessly fed upon the roots of oats. They were also found in wheat and corn fields but not in such large numbers.

THE PUPA.—The transformation from the larva to the pupa leaves the newly formed individual, as a rule, within the old larval moult from which it has just emerged. At first it is creamy white but soon changes to a dark yellow until just before the end of the period the head, thorax, wings, legs, and last abdominal segments assume a still darker hue. The pupæ are from 14 to 16 mm. long and from 6 to 7 mm. wide. Movement results from raising and lowering the abdomen. They are easily distinguished from the pupæ of *Lachnosterna* by the absence of the long protuberances at the tip of the abdomen and their much smaller size. In life-history cages, pupæ were collected as early as August 24, but the majority of the individuals were found soon after September 1 and continued to be present throughout the entire month. Pupæ collected in the fields, during the month of September served as a check on the cage observations. The average length of the pupal stage for 126 individuals was 16 days, with a minimum of 13 days and a maximum of 22 days.

THE ADULT.—Horn (1884, p. 158) describes *Anomala binotata* as follows:

"Form moderately robust, piceous; thorax dark bronze, shining; elytra yellowish testaceous, the suture and margin narrowly bordered, and usually on each side two piceous spots. Head rather densely punctured. Clypeus scarcely broader at base, the margin narrowly reflexed. Thorax narrowed in front; sides arcuate, disc convex, sparingly punctured, toward the sides more densely and with a larger foveate puncture. Scutellum bronzed. Elytra, with striæ, of coarse punctures, somewhat confused in the sutural region, three of the intervals very slightly more elevated. Pygidium rather densely rugulose, and with short hairs. Body beneath coarsely, not densely punctured, pectus, coxal plates and sides of abdomen hairy. Length .40-.44 inch; 10–11 mm.

"The claw joint of the anterior tarsi is distinctly toothed beneath. The anterior claw is flexed at base, the tip cleft, the upper portion quite slender, and a little shorter than the lower. The anterior claw of the middle tarsus is cleft at tip, the two portions nearly equal."

The adults of this species are notably injurious to the blossoms and foliage of fruit-producing plants. They fly by day, often at dusk and infrequently at night, being attracted to lights. They begin to mature by September 6 but remain in their pupal cells until the following spring. According to Hart (1911, p. 73) mating occurs on the surface of the soil where the females attract the males, after which the females enter vertical burrows in the soil presumably to deposit eggs. Males can be distinguished from the females by the antennal club which is

longer than the funiculus in the male and about equal in length to the funiculus in the female.

Birds are known to feed on the adults of this species. McAtee (1908, pp. 26 and 44) reports cardinals and rose-breasted grosbeaks feeding on *Anomala binotata* and Beal (1912, pp. 17 and 54) cites the kingbird and yellow-bellied fly catcher. The writer found one specimen in the stomach of a toad taken in a corn field in May.

To summarize, the adults of *Anomala binotata* are injurious to fruit-producing plants and the grubs are minor pests of corn, wheat and oats. The winter is passed as an adult. Eggs are laid in the spring and soon hatch, producing larvæ whose average time of development was found to be 83 days. The pupal stage lasts on an average 16 days. The adults transform in the fall and remain in their pupal cells until the following spring, thus completing a one-year life cycle.

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NOTES ON THREE SPECIES OF APPLE LEAF-HOPPERS

By FRANK H. LATHROP, *Assistant Entomologist, Oregon Agricultural Experiment Station*

While connected with the New York (Geneva) Agricultural Experiment Station the writer had opportunity to make observations on the life-histories and habits of three important leaf-hoppers attacking apple.

The three species of leaf-hoppers, *Empoasca mali* LeBaron, *Empoasca unicolor* Gillette, and *Empoa rosæ* Linnæus, which are discussed in this paper, are quite similar in general appearance. Especially is this true of the two species of Empoasca and the nymphs of all three species.

DISTINGUISHING CHARACTERISTICS

The nymph of *Empoa rosæ* may be distinguished by its white color, as well as by the contour of the anterior margin of the vertex. The

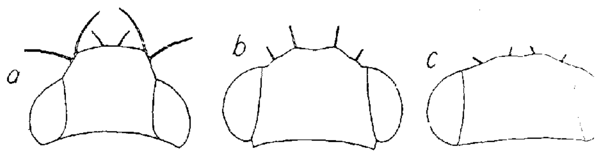

Fig. 5. Heads of leaf-hopper nymphs, showing comparative structures and sizes: *a, Empoa rosæ, b, Empoasca mali, c, Empoasca unicolor.*

nymphs of both the other species are green, and by this character may be separated from the preceding form with little difficulty. The two Empoasca nymphs are very closely similar, and are very easily confused. The nymph of *Empoasca unicolor* differs most distinctly from that of *E. mali* in the contour of the anterior margin of the vertex and there is also a difference in the coloration of the two species.

The adult of *Empoa rosæ*, like the nymph, is recognized by its white

or whitish color. The adult of *Empoasca unicolor* is larger and a trifle more robust than that of *E. mali* and the coloration of the two is quite distinct. However, the most reliable distinctive characteristics are the form of the female genitalia and the contour of the anterior margin of the vertex.

Seasonal Activities

During the summer and fall of 1915 the district of western New York about Geneva experienced a heavy infestation of the apple leaf-hopper, *Empoasca mali*. The foliage of apples in nursery plantings and of young orchard trees was severely curled. Similar injury was commonly observed on various ornamental nursery stock, and the writer's attention was especially attracted by the injury to Norway maple and cut leaf birch. During this season infestation by *Empoa rosæ* was also quite common, and their attacks were in evidence in all orchards observed. *Empoasca unicolor*, on the other hand, seemed to be comparatively rare, and no cases of heavy infestation were observed.

The season of 1916 was fully two weeks later than normal, and there was a consequent delay in the beginning of insect activities. During the spring and summer of this season conditions were somewhat reversed with respect to leaf-hopper abundance. *Empoasca mali*, though still decidedly injurious, was much less in evidence than during the preceding season, while *Empoasca unicolor* was exceedingly plentiful, proving to be a true pest and by far outnumbering *E. mali*. *Empoa rosæ* was again prevalent, and, in spite of its natural enemies, did considerable injury.

Life-History Studies

Empoa rosæ. This species spends the winter in the egg stage. By far the larger number of the winter eggs are deposited in the bark of the rose although a few occur on apple.

On May 20, nymphs were found emerging from eggs on rose. The young nymphs immediately migrated to the underside of the leaves and began feeding. The hatching of nearly all of the eggs occurred almost simultaneously, and within a few days all of the nymphs had apparently emerged. The nymphs were common on roses, and many cases of very heavy infestation were observed. The apple, on the contrary, was almost entirely free of infestation, and only occasional nymphs of this generation could be found on this plant.

The first adults of the season appeared during the second week in June, and from that time on, the number of adults increased, until, by the latter part of the month, practically all the nymphs had transformed. The adults migrated to apple, and after this, the rose was almost deserted. After the middle of July the adults began to decrease

noticeably, and by the latter part of the month had become comparatively rare.

After migration, the eggs were deposited on apple. Nymphs of the second generation appeared during the middle of July, and during early August the adults of this generation occurred in numbers. The nymphs of the second generation reached their greatest abundance during the last week of July and the first week in August. From this time on, the nymphs became less numerous, and by early October, had become rare, although at this time the adults were numerous on apple.

Migration now occurred from the apple to the rose, where the winter eggs were deposited.

Empoasca mali. The observations made at Geneva during this study show that this species hibernated largely, if not exclusively, in the adult form. During the winter, three dozen one- and two-year-old

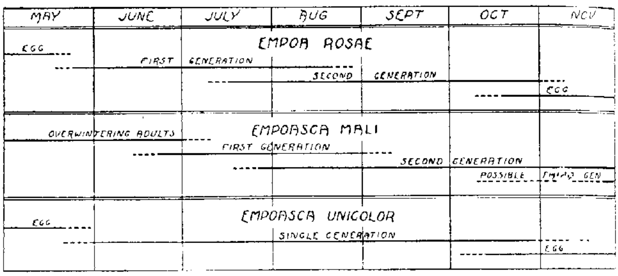

Fig. 6. Life-cycles of apple leaf-hoppers as observed at Geneva, New York, during the seasons of 1915 and 1916.

apple stock were planted in the greenhouse. Numbers of leaf-hopper nymphs soon emerged from eggs deposited in the bark. The appearance of the nymphs was such that they might easily have been mistaken for *Empoasca mali*, but when the adults developed, they proved without exception to be *Empoasca unicolor*. No nymphs of the former species appeared.

In the orchards, nymphs of *E. mali* appeared in numbers during the last ten days in June. This is obviously too early for the appearance of nymphs of the second generation, and is much too late for the hatching of the winter egg, had hibernation taken place in that stage.

There was considerable variation in the ages of the nymphs of this first generation, and the more advanced matured in early July. By the middle of July, the great majority of the nymphs were in the later instars and the adults were becoming very numerous. Nymphs of the second generation began to appear during the latter part of the month,

but the increase in the numbers of adults was more rapid than the increase in the numbers of the nymphs, so that during early August, the adult was the greatly predominating form. During the first half of August nymphs of the second generation gained the ascendency, and it was during this period that the earliest adults of the second generation appeared. By late September adults were very abundant, and most of the nymphs were of the later instars. However, all stages of the insect continued to be present until frosts killed the remaining nymphs. It seems quite probable that these nymphs which emerged so late in the season represented a third generation from eggs deposited by the more precocious adults of the second generation. It is doubtful if any of these reached maturity and were able to pass the winter. No evidence of oviposition in the bark of the infested trees could be found.

Empoasca unicolor. This species spends the winter in the egg stage. The hatching occurred somewhat later than that of *Empoa rosæ* and nymphs appeared during the last week in May. Development was slow as compared with the other species under observation, and adults did not appear until the first week in July. By the middle of the month all of the nymphs had matured. The insect is single brooded, and no eggs were observed until late fall, when the overwintering eggs are deposited in the bark of the apple.

Fig. 7. Typical injury to apple by *Empoasca mali*.

Habits and Nature of Injury

When living on the apple, *Empoasca mali* is found feeding almost exclusively on the tender terminal growth, and it is for this reason, perhaps, that the species shows a marked preference for young, growing trees. *Empoa rosæ* and *Empoasca unicolor* both confine themselves very largely to the older leaves, although they occur on both old and young trees. However it was noticed that *Empoa rosæ* was more prevalent on the older trees, while *Empoasca unicolor* was most abundant on younger trees.

The attack of *Empoasca mali* causes a severe and characteristic curling of the foliage and resultant injury to the tree. Both of the other species destroy the chlorophyl of the leaves, with a consequent reduction of their value to the tree.

Fire Blight Transmission

A series of experiments was undertaken to determine the possibility

of the transmission of fire blight by these insects. Rapidly growing two-year-old apple shoots in the greenhouse were infected with the organism obtained from exudate from infected twigs in the orchard. These shoots were enclosed in fine netting bags, and when the disease had developed, the leaf-hoppers were introduced. After feeding for from several hours to a day, the insects were transferred to healthy shoots and allowed to feed.

The results may be briefly summarized as follows:

Expt. No. 1.	Five adults *Empoasca unicolor*	Negative
Expt. No. 2.	Two adults *E. unicolor*	Doubtful
Expt. No. 3.	Fourteen nymphs *E. mali*	Positive
Expt. No. 4.	One adult *E. unicolor*	Negative
Expt. No. 5.	Two nymphs *E. mali*	Negative
Expt. No. 6.	Six nymphs *E. mali*	Positive
Expt. No. 7.	Ten nymphs *Empoa rosæ*	Negative
Expt. No. 8.	Ten nymphs *Empoasca mali*	Positive
Expt. No. 9.	Five nymphs *E. mali*	Negative
Expt. No. 10.	Two adults *E. unicolor*	Negative

Of the five transfers of the nymphs of *E. mali*, three gave positive results. The tests with adults of *E. unicolor* were negative, except in one case which was doubtful. The test with *Empoa rosæ* resulted negatively. The negative results should not be taken to indicate that these species are incapable of transmitting the disease.

IMPORTANT NOTICE

At the Pittsburgh meeting of the Association it was voted that the Secretary be instructed to prepare an Honor Roll of the members of the Association who are in the United States or allied service.

In order to do this and secure an accurate record, it is necessary to have the fullest coöperation of the members. It is requested that each member send to the undersigned as soon as possible the records of any members of the Association who are in the services above mentioned, with as much detail as possible as to their rank and the regiment or other military unit to which they are attached.

A. F. Burgess,
Secretary.

Scientific Notes

Eriophyes ramosus n. sp. An interesting infestation by eriophyid mites was brought to my attention by Dr. E. P. Felt on a specimen of *Juniperus pachyphlæa* from Williams, Arizona. The juniper was received from Prof. E. Bethel, State Museum, Denver, Colorado.

The twig bore several large, more or less deformed, infertile fruits. On the surface of each were several minute circular openings. Upon dissection, the berries were found to be literally alive with the mites which had entirely destroyed the inner cellular structures. In some of the fruits the creatures were so abundant that their bodies entirely filled the cavity.

A similar injury has been mentioned by Dr. A. Nalepa on *Juniperus communis* L. in Europe and is said to be caused by *E. quadrisetus typicus* (F. Thom.). The American form differs in several respects from the foregoing species and may be recognized by the following characters:

The body is small, cylindrical, uniform in width, and very long. Length 231μ, width 59μ.

The thoracic shield is small, triangular in form and slightly arched. Its lateral margins are gently rounded and partially cover the trochanter. The anterior margin is acuminate and projects over the rostrum, while the posterior margin is gently rounded. The dorsal setæ are longer than the shield, rather fine and are usually directed anteriorly. The setal tubercles are of medium size, nipple like, being situated widely apart near the posterior margin but not projecting beyond. The rostrum is of medium length, stout, strongly curved, and projecting forward and obliquely downward. The rostral bristles are long and stout. The claw is truncate, curved, slightly shorter than the feathered hair which is 9-rayed and very strong.

The thoracic setæ are all present. T. setæ I are very long, and placed at some distance from the anterior end of sternum. T. setæ II are very long, widely separated and situated opposite the inner epimeral angles. T. setæ III are of medium length and situated about midway between the inner and outer epimeral angles.

The *abdomen* is cylindrical, having 72 striæ which are finely punctured along the posterior margin. The dorsum and ventrum are similar in character. The *setæ* are all present. The Lateral setæ are about equal to Ventral setæ I in length; the Genital setæ are of medium length and stout; setæ Ventral I are of medium length, fine and do not appear to overreach setæ Ventral II; setæ Ventral II are longer than the genital setæ; setæ Ventral III are very stout, reaching the ventral lobes. The accessory and caudal setæ are present, each pair being very long and stout. The epigynium is wide, semicircular and has a coarse distinct sculpturing on the epigynial plate.

Superficially these mites may be recognized by a pinkish to dark-red coloration and the great length and narrowness of the body.

H. E. Hodgkiss,
N. Y. Agricultural Experiment Station, Geneva, N. Y.

Nicotine Sulphate an Effective Ovicide for Codling Moth Eggs. Following the remarkable results of F. E. De Sellem[1] of N. Yakima, Washington, with nicotine sulphate as a control for codling moth, experiments have been undertaken seeking to throw additional light on the subject and afford a satisfactory explanation of the

[1] 1916. De Sellem, F. E. Nicotine Sulphate for Codling Moth Control. Ann. Rept. Hort. Dept. N. Yakima for 1916, p. 62.

matter. In addition to the work already reported, a test[1] was made of the ovicidal value of nicotine sulphate for the eggs of codling moth.

On August 31, codling moth eggs deposited on apples were collected in the field. These eggs varied from those recently deposited to those just ready to hatch. The eggs were examined carefully in the laboratory under a binocular and the position of those appearing perfect in every way was indicated on the fruit by drawing a circle about the egg some little distance away with Higgins waterproof ink. The apples were then so cut as to leave the egg uppermost when the apple was laid on a table. The apples were then sprayed by means of a quart hand sprayer, throwing a very fine mist-like spray. The following materials were used:

No. 1—Black Leaf 40, 1-1200.

No. 2—Black Leaf 40, 1-400.

No. 3—Black Leaf 40, 1-1200 plus fish oil soap at the rate of 4 pounds to 100 gallons.

No. 4—Check.

The final count of results was made on September 8 and gave the following:

	Hatched	*Unhatched*	*Total*	*Per Cent Unhatched*
No. 1	7	38	45	84.5
No. 2	9	36	45	80.0
No. 3	0	26	26	100.0
No. 4	19	5	24	20.8

In the case of No. 1, two eggs were parasitized, No. 2, two eggs parasitized, No. 3, three eggs parasitized; the parasites in all cases apparently dead. In the case of No. 4, two of the unhatched eggs appeared infertile.

Nicotine sulphate is an effective ovicide for codling moth eggs. The addition of soap renders it practically perfect in this regard.

A. L. LOVETT, *Entomologist,*
Oregon Experiment Station.

MEETING OF OHIO ENTOMOLOGISTS

For some years it has been the custom for the entomologists of Ohio institutions to hold an annual meeting, the main purpose being to correlate the entomological activities of the State. Such meetings are open to active entomologists and students specializing in entomology.

At the recent meeting held in the botany and zoölogy building of the State University, thirty-seven entomologists were present and an excellent program of twenty-two short papers and addresses was rendered.

PACIFIC SLOPE BRANCH

The annual meeting of the Pacific Slope Branch of the American Association of Economic Entomologists will be held at Pasadena, Calif., March 28, 29 and 30. The gathering last year was a most successful one and the unusual conditions now prevailing justify and demand the utmost from every entomologist. There is nothing better than conference to promote coöperation and efficiency. Geo. P. Weldon, Sacramento, is vice-president for the Section and E. O. Essig, Ventura, secretary.

[1] 1917. Lovett, A. L. Nicotine Sulphate as a Poison for Insects. JOUR. ECON. ENT., vol. X, No. 3, p. 333.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

FEBRUARY, 1918

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. Photo-engraving may be obtained by authors at cost. The receipt of all papers will be acknowledged.—EDS.

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The wastes of civilization, furnishing as they do breeding places for insects and affording numerous opportunities for infection, are a serious menace to human welfare. This was no problem in primitive days. The wandering tribes frequently changed camp sites and all was well. Such a course is impossible now and while modern plumbing has very generally solved or made possible the disposal of the more dangerous wastes from the home, comparatively little has been done for the adequate care of those from the stable. The suggestion of Mr. Cory in the January issue of the Emergency Entomological Service of the United States Department of Agriculture is of more than passing interest. The rapid drying of manure not only reduces weight and prevents insect breeding but renders such material less obnoxious, tends to its more general utilization as a fertilizer, and indirectly it means a marked lessening of the insect menace. Such a process or some modification may not be profitable, judged solely from immediate and tangible returns and yet pay large dividends if due allowance is made for the protection thereby secured from disease. The necessities of the army may result in working out a method which can be applied to city and village conditions. This is one of the practical problems of present day sanitation, and one which should be speedily solved.

The prohibition of the importation of all nursery stock, except what may be imported by the Secretary of Agriculture for experimental and

scientific purposes, is the object of Senate Bill 3344. It has the backing of a number of forestry associations and primarily is an outcome of the chestnut blight and white pine blister rust situation, especially the latter, though the ravages of imported insects have also had a bearing upon the matter. Brief in text, its provisions are sweeping in character, since it prohibits, except as stated above, the importation of "nursery stock," including "all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable and flower seeds, bedding plants, and other herbaceous plants, bulbs, and roots." The scope of this bill is so broad and the change so great that it should not be allowed to pass until all interests affected have had a chance to study its provisions most carefully and an opportunity to present their side of the case. It vitally affects our extensive horticultural interests and should therefore be given most careful consideration.

Current Notes

Conducted by the Associate Editor

The *Review of Applied Entomology* announces the death of Mr. C. W. Mason, Government Entomologist in Nyasaland.

Miss Anna Wuentz has been appointed graduate assistant in Entomology at the Minnesota Station, beginning January 1, 1918.

The Hawaiian Sugar Planters' Station has a new building which provides fireproof quarters for the entomological collections.

Professor H. A. Morgan represented Tennessee at the meeting of federal food administrators at Washington, D. C., January 9 and 10, 1918.

Dr. J. C. Bradley gave an illustrated lecture on December 19, on "The Okefinoke," before the monthly meeting of the California Academy of Sciences.

Dr. D. L. Crawford of Pomona College, Claremont, Cal., has been appointed professor of Entomology at Hawaii College and has entered upon his duties.

Mr. William D. Kearfott, head of the Kearfott Engineering Company of New York City, and a specialist in the microlepidoptera, died November 13, 1917.

First Lieut. A. H. Jennings, formerly of the Bureau of Entomology, has been ordered to report at Camp Shelby, Hattiesburg, Miss., for duty in the Sanitary Corps.

Mr. R. D. Whitmarsh, assistant entomologist of the Ohio Station, has been commissioned a captain in the Officers' Reserve Corps and assigned to duty at Camp Grant, Rockford, Ill.

Messrs. Leonard S. McLaine and W. H. Brittain of the office of the Dominion Entomologist, Canada, were visitors at the gipsy moth parasite laboratory, Melrose Highlands, Mass., in November.

Mr. W. R. Walton, in charge of cereal crop insect investigations of the Federal Bureau of Entomology, visited the Department of Entomology, Kansas State Agricultural College, on November 1.

A fire at Mount Holyoke College on December 22, 1917, destroyed Lyman Williston Hall, containing the biological science laboratories and museum. All entomological collections were destroyed.

Dr. H. T. Fernald, Amherst, Mass., has resigned as state nursery inspector, a position under the Board of Agriculture which he has held for fifteen years, and his deputy, Mr. R. H. Allen, has been appointed in his place.

Prof. Herbert Osborn of Ohio State University, and Dr. E. D. Ball, state entomologist of Wisconsin, spent several days in Washington, D. C., in November with Mr. E. H. Gibson, examining types of Homoptera at the National Museum.

The program of Sunday afternoon lectures given in the Museum of Golden Gate Park, San Francisco, Cal., included a lecture for December 16, on "The Growth and Transformations of Insects," by Professor E. O. Essig of the University of California.

Mr. T. L. Guyton and Mr. J. R. Stear, graduates of Ohio State University, have been appointed assistants on the entomological staff of the Ohio Experiment Station at Wooster. Last year Mr. Stear was assistant instructor in Entomology, University of Illinois.

Professor H. A. Gossard, entomologist of the Ohio Station, read a paper before the National Nut Growers' Association, Biloxi, Miss., October 10, in answer to the question, "Has any standard fruit industry as few diseases and insect enemies as the pecan?"

The following resignations from the Bureau of Entomology have been reported: Gerson Garb, extension work, truck crop insects, Mineola, L. I.; Harry W. Allen, scientific assistant, and G. E. Clement, assistant in forest management, Melrose Highlands, Mass.

Mr. E. Lee Worsham has resigned his position as state entomologist of Georgia in order to devote his time entirely to the conservation of the Sea Island cotton industry. He will be engaged in cotton production on Sapelo Island, and his address will be Sapelo, McIntosh County, Ga.

According to *Science*, Dr. A. B. Cordley, Dean of Agriculture at the Oregon Agricultural College, and Director of the Station, has been elected chairman of the State Lime Committee, authorized by the legislature to build and operate a state-owned lime plant for providing cheap agricultural lime.

Moving picture films showing various phases of the gipsy-moth investigation were exhibited at the meeting of the Entomological Society of Ontario at McDonald College, and also at Ottawa, Canada, during November, and at the Pittsburgh meeting of the American Association of Economic Entomologists.

According to *Science*, Professor W. B. Herms of the University of California has been making an entomological survey of sanitary conditions in the neighborhood of the cantonments of the western department of the army, to aid in preventing the spread of those diseases, such as malaria, which are carried by insects.

The Association of Economic Biologists, at a recent meeting of the Council, decided to throw open its membership to non-British subjects. Foreign members will there-

fore have the same privileges as British ones, including the right to receive the *Annals of Applied Biology* for the annual subscription of 1 guinea (sold at 25s. to the public).

The entomological laboratory of the Tennessee Station has recently been equipped with an electric incubator, fitted with an extremely sensitive thermo-regulator. It has ample space for a large amount of material, also for a recording thermometer and hydrograph, and thermometers and a hydrograph by which the recording instruments are regulated.

Mr. Donald J. Caffrey, in charge of the Hagerstown, Md., field station of the Bureau of Entomology, visited the New England States during his vacation in December and January, and called at the entomological laboratories of the Massachusetts Agricultural College, Amherst, Mass., and the Connecticut Agricultural Experiment Station, New Haven, Conn.

Mr. Charles F. Baker, who for the past year has been assistant director of the Botanic Gardens at Singapore, and previously professor of Agronomy at the Philippine College of Agriculture, has been recalled to the Philippines to become dean of the College of Agriculture and professor of Tropical Agronomy on account of the mid-year retirement of Dean Copeland.

Mr. William M. Mann, Bureau of Entomology, has recently been commissioned to go to Cuba to continue the work which Harold Morrison was doing there in relation particularly to the white fly and other insects affecting tropical and subtropical plants, having more particular relation to pests against which it may be necessary to take quarantine or other restrictive measures to exclude from the Continental United States.

A general conference of the Hessian-fly staff was called in Washington for the first week in January, for the purpose of comparing notes, for consultation with the Chief of the Bureau and others, but especially to consider the Hessian-fly problem in connection with adaptations and modifications of agronomic practice. Experts from the U. S. Bureau of Plant Industry will be detailed to meet the Hessian-fly men in joint conference.

According to *Science* Dr. C. Gordon Hewitt, F. R. S. C., dominion entomologist and consulting zoölogist of the Department of Agriculture, Ottawa, has been awarded the gold medal of the Royal Society of Canada for the Protection of Birds, and has been elected an honorary fellow of the Society, in recognition of his services to the cause of bird protection in England and in Canada, and particularly in connection with the treaty between Canada and the United States for the protection of migratory birds.

Dr. L. P. de Bussy, formerly biologist to the Tobacco Planters' Association at Deli, Sumatra, who visited this country in 1910 in the effort to get parasites of injurious tobacco insects for importation into Sumatra, visited the Bureau of Entomology early in November on his way back from Sumatra to Amsterdam, where he is to take the position of Director of the Dutch Colonial Museum. Doctor de Bussy reports that *Trichogramma pretiosa* was successfully introduced and established in Sumatra.

Mr. M. A. Yothers, assistant entomologist of the Washington Agricultural Experiment Station, has resigned to accept a position with the Federal Bureau of Entomology at Medford, Oregon, where he will investigate fruit insects. His place has been

filled by the appointment of Mr. Anthony Spuler, B. S. in Entomology, a graduate of the Washington State College. Mr. Spuler will give his entire time to an investigation of cranberry insects in southwestern Washington, in coöperation with the Federal Bureau of Entomology.

Professor Vernon Kellogg has been associated with Herbert Hoover in the work of the Commission for Relief in Belgium since May, 1915, and in the work of the United States Food Administration since its organization. Professor Kellogg's duties in the Food Administration are advisory and editorial He also gives special attention to matters connected with the food conditions among the Allies. Professor Kellogg gave the annual address before the Entomological Society of America at Pittsburgh, Pa., December 28.

Professor H. Maxwell-Lefroy, formerly Imperial Entomologist in India, and now lecturer on applied zoölogy at the Imperial College of Science, London, visited Washington, D. C., in November on his way from England to Australia, where he is going to investigate weevil damage to stored wheat which is to be shipped from Australia to the United States. On his trip he visited the Department of Entomology at the Kansas State Agricultural College, November 26 and 27, and gave an excellent address before the Zoölogical and Entomological Seminar on "Medical Entomology in the English Armies."

The Board of Regents of the University of Minnesota at their meeting on January 18 elected Dr. W. A. Riley of Cornell, Professor of Parasitology and Chief of the Division of Economic Zoölogy. Associate Professor A. G. Ruggles was, at the same time, appointed Station Entomologist which position carries with it the office of State Entomologist. At the December meeting of the Board Professor F. L. Washburn, who has held the position of State Entomologist in Minnesota for nearly sixteen years, asked and obtained permission to be relieved of that position and its attendant police duties, and the action of the Board on the 18th was necessary to fill the vacancy thus caused.

Dr. E. F. Phillips, Bureau of Entomology, returned November 14 from an extended western trip, taken for the purpose of arranging for extension work in beekeeping. In addition to conferences with various extension directors, meetings of beekeepers were held in Utah, Idaho and California. Most beekeepers in the west are awake to the need of increasing honey production next year and are making plans to that end. The bee disease situation in California is more serious than had been realized, due to a failure of beekeepers to differentiate American foulbrood and European foulbrood. Many are attempting to treat American foulbrood by methods applicable only to European foulbrood with disastrous results.

Transfers have recently been made in the Bureau of Entomology as follows: Dr. J. A. Nelson, apiculture, to southern field crop insect investigations; R. A. Cushman, parasite work deciduous fruit insects, North East, Pa., to Wallingford, Conn.; G. F. Moznette, Federal Horticultural Board, Washington, D. C., to subtropical fruit insect investigations, Miami, Fla.; C. E. Bartholomew from Tennessee to take up extension work in beekeeping in Wyoming, Colorado, Utah and Idaho; L. C. Griffith, shade tree insects, to extension work with deciduous fruit insect control, Ithaca, N. Y.; Marion R. Smith, Washington, D. C., to Baton Rouge, La., truck crop insect investigations; Roy E. Campbell and Harold J. Ryan, truck crop insect investigations, have moved their headquarters from Pasadena to Alhambra, Cal.; K. L. Cockerham, truck crop insects, Muscatine, Iowa, to extension work at Agricultural College, Miss.; Harry M. Gillert, South Carolina to Raleigh, North Carolina.

The following recent appointments in the Bureau of Entomology have been announced: Robert Matheson, Cornell University, Specialist in Hymenoptera, Gipsy Moth Laboratory, Melrose Highlands, Mass.; E. F. Atwater, and G. C. Mathews, Idaho, Special Field Agents in Apiculture. Mr. Atwater will do extension work in California, Arizona and New Mexico. W. Atkins, Iowa Agricultural College, Special Field Agent, to take up extension work in apiculture in Iowa, Missouri, Kansas and Nebraska; O. G. Babcock, Colorado, to Dallas, Texas, for work in the control of insects injurious to live stock; Clyde C. Hamilton, Kansas State College, Special Field Agent for extension work in deciduous fruit insect control in Arkansas and Missouri, Columbia, Mo.; Joseph S. Stanford, Utah Agricultural College, Special Field Agent, deciduous fruit insect control in Idaho and Colorado; R. C. Pickett, Wisconsin, Special Field Agent, extension work with truck crop insects, Southern States; A. H. Sherwood, Special Field Agent, extension work in cereal and forage crop insects, Brookings, S. D.; E. G. Smyth, Porto Rico, to truck crop insect investigations, College Station, Texas; A. A. Brook, Santa Paula, Cal., collaborator truck crop insect investigations.

The following members of the Bureau of Entomology have been called to the colors:

F. L. McDonough, Quincy, Fla., to Camp Devens, Ayer, Mass.;

Geo. W. Barber, Hagerstown, Md., to Fort Leavenworth, Kan.;

Gipsy Moth Employees:

Dwight F. Barns, Flying Cadet, Signal Reserve Corps, U. S. Army, Cambridge, Mass.;

John W. Bradley, Flying Cadet, Signal Reserve Corps, U. S. Army, Cambridge, Mass.;

David Broude, Yeoman, U. S. Navy, Boston, Mass.;

Thomas M. Cannon, Private, U. S. Army, Camp Devens, Ayer, Mass.;

Henry F. Cummings, Private, U. S. Army, Camp Devens, Ayer, Mass.;

Alfred D. Darling, Pharmacist's Mate, U. S. Navy, Charlestown, Mass.;

Senekerim M. Dohanian, Flying Cadet, Signal Reserve Corps, U. S. Army, Cambridge, Mass.

Cornelius J. Driscoll, Yeoman, U. S. Navy, Washington, D. C.;

Carlisle C. Eggleston, Private, U. S. Army, Camp Devens, Ayer, Mass.;

William G. Johnson, Private, U. S. Army.

George J. McCarthy, Yeoman, U. S. Navy, Charlestown, Mass.

Willis Munro, Officers' Training Camp, Plattsburg, N. Y.;

Frederick W. Merrill, Seaman, U. S. Navy;

Rolf V. Robsham, Sergeant, U. S. Army, Camp Devens, Ayer, Mass.;

Henry J. Rosseau, Private, U. S. Army, Norwich, Conn.;

Chellis W. Stockwell, Private, Aviation Corps, San Antonio, Texas;

Orrin S. Thompson, Private, U. S. Army, Camp Devens, Ayer, Mass.

Mailed February 20, 1918.